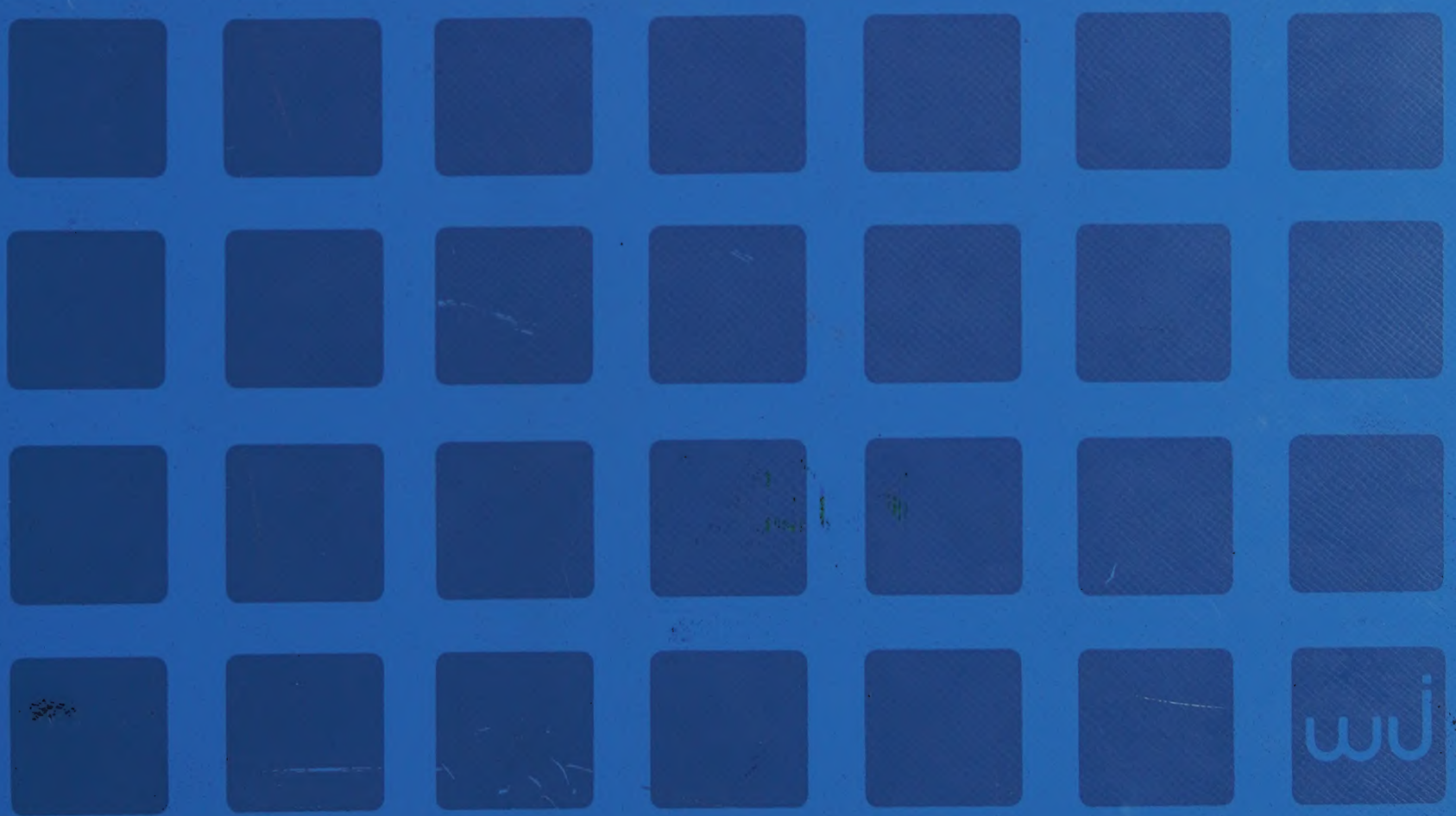
WATKINS-JOHNSON

Engineering Notebook
for
WJ-1250A and WJ-1251-9

Microwave Tubes
Solid State Products
RF Signal Processing Components
Communications Equipment
Production Test Equipment
Industrial Furnaces



WATKINS-JOHNSON

PSL
Authorized
Calibration
Procedure

1 OCTOBER 1977

Operation and Maintenance Manual

For

WJ-1250A FREQUENCY SYNTHESIZER

"This drawing, print or document and subject matter disclosed herein are proprietary items to which Watkins-Johnson Company retains the exclusive right of dissemination, reproduction, manufacture and sale. This drawing, print or document is submitted in confidence for consideration by the designated recipient or intended using organization alone unless permission for further disclosure is expressly granted in writing."

WATKINS-JOHNSON
3333 Hillview Avenue
Stanford Industrial Park
Palo Alto, California 94304

SSE-934

TABLE OF CONTENTS

		Page
SECTION 1	GENERAL DESCRIPTION	
1.1	SCOPE OF SECTION	1-1
1.2	PURPOSE OF EQUIPMENT	1-1
1.3	DESCRIPTION OF EQUIPMENT	1-2
1.4	ELECTRICAL AND MECHANICAL CHARACTERISTICS	1-2
SECTION 2	OPERATION	
2.1	SCOPE OF SECTION	2-1
2.2	CONTROLS AND INDICATORS	2-1
2.3	OPERATION	2-7
SECTION 3	THEORY OF OPERATION	
3.1	SCOPE OF SECTION	3-1
3.2	FUNCTIONAL DESCRIPTION	3-1
3.3	DETAILED CIRCUIT ANALYSIS	3-4
3.3.1	Z-80 Controller A24	3-4
3.3.2	Z-80 I/O Extender A25	3-8
3.3.3	Harmonic Generator Driver A21	3-9
3.3.4	Reference Divider and Control A4	3-13
3.3.5	500 MHz Programmable Divider A6	3-16
3.3.6	Six-Digit LED Display A9	3-16
3.3.7	Keyboard Assembly A10	3-19
SECTION 4	MAINTENANCE	
4.1	SCOPE OF SECTION	4-1
4.2	RECOMMENDED TEST EQUIPMENT	4-1
4.3	ALIGNMENT PROCEDURES	4-2
4.3.1	Power Supply PS1; Alignment	4-2
4.3.2	5 MHz XTAL Oscillator Y1; Alignment	4-4
4.3.3	100 MHz VCXO Y3; Alignment	4-5
4.3.4	YTO D/A Coarse-Tune Driver; Alignment	4-6
4.3.5	Harmonic Generator Driver A21; Alignment	4-7
4.3.6	Harmonic Generator Driver, A21; Alignment from Tuning Data	4-8
4.3.7	Harmonic Generator Driver, A21; Alignment Using Instruments	4-9
4.4	TROUBLESHOOTING PROCEDURES	4-11

TABLE OF CONTENTS (Con't.)

		Page
SECTION 5	DIAGRAMS	
5.1	SCOPE OF SECTION	5-1
5.2	SYSTEM DIAGRAMS	5-1
SECTION 6	PARTS LISTS	
6.1	SCOPE OF SECTION	6-1
6.2	USE OF PARTS LIST	6-1
6.2.1	Watkins-Johnson Part Numbering System	6-1
6.2.2	Manufacturer's Codes	6-1
6.2.3	Effectivity Application Code	6-1
6.2.4	Part Ref No.	6-2
6.3	PARTS ORDERING INFORMATION	6-2

LIST OF ILLUSTRATIONS

Figure	Title	Page
1-1	WJ-1250A Frequency Synthesizer	1-1
2-1	WJ-1250A Frequency Synthesizer; Front Panel Controls and Indicators	2-1
2-2	WJ-1250A Frequency Synthesizer; Rear Panel Controls and Connectors	2-2
3-1	WJ-1250A Frequency Synthesizer; Block Diagram	3-2
3-2	Z-80 Controller A24 and I/O Extender A25; Block Diagram	3-5
3-3	Harmonic Generator Driver A21; Block Diagram	3-10
3-4	Reference Divider and Control Assembly A4; Block Diagram	3-14
3-5	500 MHz Programmable Divider A6; Block Diagram	3-17
3-6	Six-Digit LED Display Assembly A9; Simplified Block Diagram	3-18
3-7	Keyboard Assembly A10; Simplified Block Diagram	3-20
4-1	WJ-1250A Frequency Synthesizer; Top View and Cover Removed	4-3
5-1	WJ-1250A Frequency Synthesizer; Assembly Drawing	5-3
5-2	WJ-2150A Frequency Synthesizer; RF Interconnect Diagram	5-5
5-3	Reference Divider and Control Assembly A4; Schematic Diagram	5-7
5-4	500 MHz Programmable Divider Assembly A6; Schematic Diagram	5-9

LIST OF ILLUSTRATIONS (Con't.)

Figure	Title	Page
5-5	Six-Digit LED Display and Control Assembly A9; Schematic Diagram	5-11
5-6	Keyboard Assembly A10; Schematic Diagram	5-13
5-7	Harmonic Generator Driver Circuit Card Assembly A21; Schematic Diagram	5-15
5-8	Z-80 Controller Circuit Card Assembly A24; Schematic Diagram	5-17
5-9	Z-80 I/O Extender Circuit Card Assembly A25; Schematic Diagram	5-19

LIST OF TABLES

Table	Title	Page
1-1	Electrical Characteristics; Frequency Synthesizer Mainframe	1-3
1-2	Mechanical Characteristics; Frequency Synthesizer Mainframe	1-3
1-3	Electrical Characteristics; WJ-1251-xx RF Sources	1-4
1-4	Mechanical Characteristics; WJ-1251-xx RF Sources	1-4
2-1	Front and Rear Panel Controls and Indicators	2-2
2-2	Front and Rear Panel Connectors	2-6
3-1	CPU I/O Lines	3-4
3-2	D/A Converter U1 I/O	3-9
3-3	Typical Tuning Adjustment Settings	3-11
3-4	Typical Voltages	3-13
3-5	Keyboard ROW and COLUMN Key versus Bit	3-21
4-1	Recommended Test Equipment	4-1
4-2	Power Supply Adjustment Settings	4-4
4-3	WJ-2150A Frequency Synthesizer Fault Isolation	4-12
5-1	List of Diagrams	5-1
6-1	Manufacturer's Code Numbers	6-2
6-2	WJ-1250A Frequency Synthesizer Assembly; Part Number 702001	6-7
6-3	Reference Divider and Control Circuit Card Assembly A4 Part Number 623286 and 623287	6-13

LIST OF TABLES (Con't.)

Table	Title	Page
6-4	500 MHz Programmable Divider Assembly A6 Part Number 701679 and 701680-001	6-20
6-5	Six Digit LED Display and Control Circuit Card Assembly A9 Part Number 623306-001	6-23
6-6	Harmonic Generator Driver Circuit Card Assembly A21 Part Number 701011-001	6-24
6-7	Z-80 Controller Circuit Card Assembly A24	6-35
6-8	Z-80 I/O Extender Circuit Card Assembly A25	6-38

Section 1

GENERAL DESCRIPTION

1.1 SCOPE OF SECTION

This section states the purpose of, and provides a general description of, the WJ-1250A Frequency Synthesizer.

1.2 PURPOSE OF EQUIPMENT

The WJ-1250A Frequency Synthesizer (Figure 1-1) provides highly stable, phase-locked, output signals over the 0.1 to 40 GHz range when the WJ-1251-xx microwave RF plug-ins are used. The synthesizer is ideally suited for test applications requiring stability, spectral purity, and computer programmability. Because of its versatility, accuracy, and dependability, the WJ-1250A Frequency Synthesizer can be used in the operation and maintenance of: automatic microwave test systems; receiver installations; laboratory equipment; meteorological devices; near-field and far-field antenna sites. It can also be used as a stable local oscillator (LO) signal source in special purpose receivers, and in the testing of space communication systems.

77-H-092

Figure 1-1. WJ-1250A Frequency Synthesizer.

1.3 DESCRIPTION OF EQUIPMENT

The WJ-1250A Frequency Synthesizer provides a stable, spectrally pure, output signal. This signal is obtained by phase-locking a yttrium-iron garnet crystal (YIG) tuned fundamental oscillator, in the RF source, to an oven-enclosed reference oscillator in the mainframe. The signal is processed, and frequency and phase compared with a 100 KHz reference; a correction current is generated which forces the YIG-tuned oscillator (YTO) output to phase lock with the 5 MHz reference.

Long term frequency stability is better than one part in 10^{-9}/24 hours and + five parts in 10^{-8} over the 0^{o} C to 50^{o} C operating temperature range, or as determined by an external 5 MHz reference oscillator.

There are twelve standard plug-in microwave RF sections available for use with the WJ-1250A. Each section consists of a WJ-1251-xx RF Source. The main chassis can accommodate a number of standard RF sources with output frequencies ranging from 0.1 to 40 GHz.

NOTE

Additional RF sources may be ordered to meet customer requirements.

The WJ-1250A can be manually programmed at the front panel keyboard or remotely by digital commands input to a rear panel connector.

The Synthesizer is completely self-contained with its own power supply and is ruggedly constructed with a light weight aluminum alloy chassis.

NOTE

Due to the extra power requirements of the WJ-1251-9 and WJ-1251-10 RF Sources, an external power supply is required when the plug-ins are used with the WJ-1250A Frequency Synthesizer.

1.4 ELECTRICAL AND MECHANICAL CHARACTERISTICS

Tables 1-1 through 1-4 provide electrical and mechanical characterisitcs of the WJ-1250A mainframe and WJ-1251-xx RF plug-in units.

Table 1-1. Electrical Characteristics, Frequency Synthesizer Mainframe

CHARACTERISTIC	SPECIFICATION
Frequency Range	0.1 to 40 GHz depending upon RF Source.
Frequency Resolution	100 KHz at≦18 GHz 200 KHz at>18 GHz
Frequency Stability	1×10^{-9}/24 hours and $\pm 5 \times 10^{-8}$ over 0 °C to 50 °C range or as determined by external 5 MHz reference oscillator.
External Reference Voltage	>1V RMS into 5 K-Ohms
Environment	0 °C to 50 °C operating; -20° C to + 70 °C storage.
Power	115 or 230 Vac ± 10%, 50 to 60 Hz, 200 watts max.

Table 1-2. Mechanical Characteristics, Frequency Synthesizer Mainframe

CHARACTERISTICS	SPECIFICATION
Size	5.22 x 19 x 22 inches. (133 x 483 x 559 mm)
Weight	40 lbs. (18.1 kg)

Table 1-3. Electrical Characteristics, WJ-1251-xx RF Sources

RF SOURCE	FREQUENCY RANGE (GHz)	UNLEVELED POWER OUT	LEVELED POWER OUT	HIGH POWER OPTION	
				UNLEVELED	LEVELED
WJ-1251-2	1-2	20 mW	10 mW	40 mW	20 mW
WJ-1251-3	2-4	15 mW	8 mW	20 mW	10 mW
WJ-1251-4	4-8	10 mW	5 mW	20 mW	10 mW
WJ-1251-5	8-12.4	15 mW	8 mW	20 mW	10 mW
WJ-1251-6	12.4-18	10 mW	5 mW	15 mW	7 mW
WJ-1251-7	8-18	5 mW	2 mW	N/A	N/A
WJ-1251-8	1-4	10 mW	5 mW	20 mW	10 mW
WJ-1251-9	18-26.5	4 mW	N/A	N/A	N/A
WJ-1251-10	26.5-40	1 mW	N/A	N/A	N/A
WJ-1251-11	2-8	5 mW	2 mW	N/A	N/A
WJ-1251-12	0.1-4	10 mW	10 mW(0.1-2 GHz)	20 mW	20 mW (0.1-2 GHz) 10 mW (2-4 GHz)
WJ-1251-13	3.7-8.4	7 mW	4 mW	N/A	N/A
WJ-1251-25	9.2-10.2	See Note	N/A	N/A	N/A

NOTE: RF Modulated + 6 dBm (Min.)
RF Reference + 10 dBm (Min.)

Table 1-4. Mechanical Characteristics, WJ-1251-xx RF Sources

RF SOURCES	SIZE	WEIGHT
WJ-1251-2 through WJ-1251-8, -13, and -25	5 1/4 x 4 1/2 x 16 5/8 inches (130 x 114 x 423 mm)	8.5 lbs (3.85 kg)
WJ-1251-9, WJ-1251-10, and WJ-1251-12	5 1/4 x 4 1/2 x 16 5/8 inches (130 x 114 x 423 mm)	11.5 lbs (5.2 kg)

Section 2

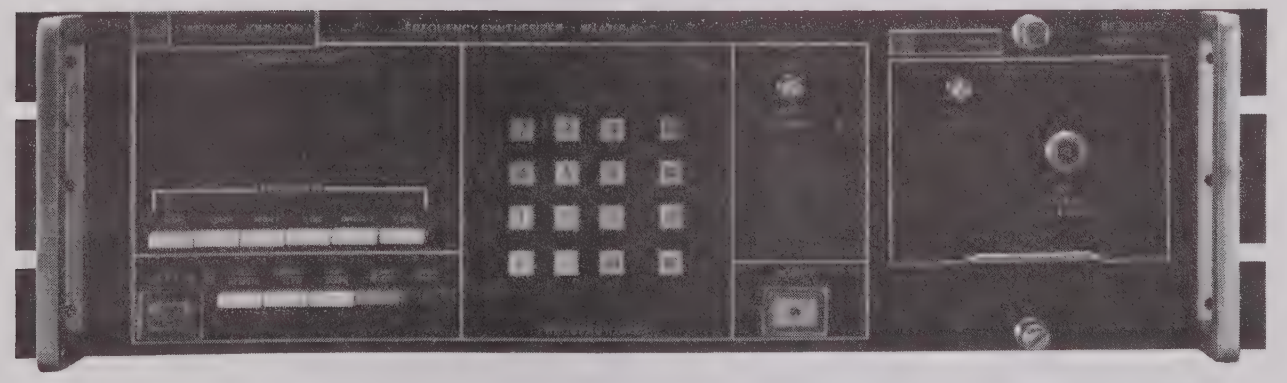
OPERATION

2.1 SCOPE OF SECTION

This section provides a summary of front and rear panel controls, front panel indicators, and instructions on how to place the WJ-1250A Frequency Synthesizer in operation. Also included is a complete list of pertinent electrical and mechanical characteristics.

2.2 CONTROLS AND INDICATORS

Figure 2-1 shows the front panel controls and indicators for the WJ-1250A Frequency Synthesizer. Figure 2-2 shows the rear panel controls and connectors. Table 2-1 is a functional description of the controls and indicators. Table 2-2 is a list of the front and rear panel connectors and their functions.



77-H-093

Figure 2-1. WJ-1250A Frequency Synthesizer, Front Panel Controls and Indicators.

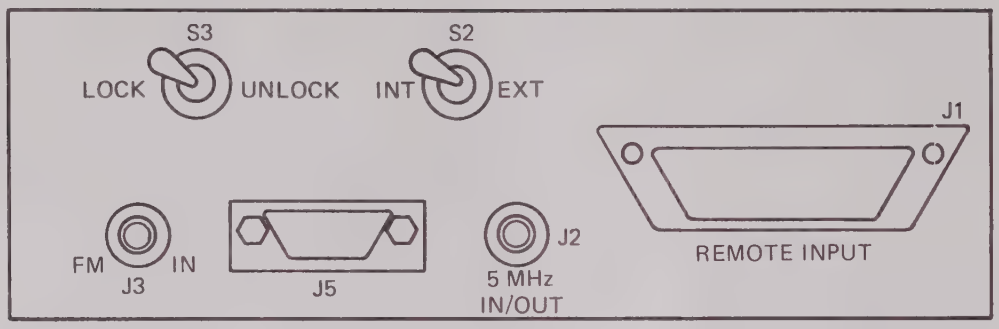


Figure 2-2. WJ-1250A Frequency Synthesizer, Rear Panel Controls and Connectors.

Table 2-1. Front and Rear Panel Controls and Indicators

CONTROL/INDICATOR	FUNCTION
Keyboard:	A 16-key matrix of which zero(0) through nine(9) and a decimal point(.) are used to manually select frequencies.
CLR (Clear)	The CLR key clears the unit's display and refreshes it to data stored in a preselected register (by front panel PROGRAM switches) within the unit.
RST (Restart)	The RST key initiates a programmed sweep of the RF output frequency. When the UP/DOWN pushbutton is in the UP configuration, the value of the Low F register is used as a reference point to start the upward frequency sweep. When the same pushbutton is in the DOWN configuration, the value of the High F register is used.
ENT (Enter)	The ENT key enters displayed frequency data into a preselected register; by front panel PROGRAM switches.
RCL (Recall)	The RCL key is used to recall, or display, the stored data contained in any one of 20 random registers. When RCL is pressed, the unit's display will show an F-. This indicates that the register file address is being sought by the unit.

Table 2-1. Front and Rear Panel Controls and Indicators (Continued)

CONTROL/INDICATOR	FUNCTION
	At this point, a two-digit entry must be made by the operator; 01 through 20. As the last digit key is released, the contents of the file is displayed. Subsequently, this data can be stored in any of the sweep parameter registers (depending upon the setting of the front panel PROGRAM switches) by pressing the ENT key..., or the data can be stored in any of the 20 random registers..., or it can be cleared from the display by pressing the CLR key. This data recall is a non-destructive read of stored data, thus the data is still in storage until new data is written over the old..., or whenever the unit's on/off power is cycled.
STO (Store)	The STO key is used to store displayed data into one of 20 register file locations. When pressed, the display will show an F- indicating that the operator must enter the file address where the data is to be stored. At this point, a two-digit entry must be made by the operator: 01 through 20. As the last digit key is released, the data is stored and the display refreshes to the data contained in the sweep parameter register; as established by the PROGRAM switches.
Display	A six-digit light-emitting diode (LED) readout with a fixed decimal point located in the second digit. The display is used to show data as it is being keyed in, the contents of the five sweep parameter registers, and 20 storage files. When an invalid frequency is programmed to the F Out register, the display will start flashing (except digit two) indicating an improper frequency has been selected. The display also contains a LED, which when off, indicates that the display is showing the unit's output frequency.
PROGRAM Switches:	A six-segment (pushbuttons) switch which is used in selecting the sweep parameter registers for data input and display.

Table 2-1. Front and Rear Panel Controls and Indicators (Continued)

CONTROL/INDICATOR	FUNCTION
F OUT (Frequency Output)	Selects the frequency output register. The unit's RF output frequency is then displayed.
DWELL T (Dwell/Slew Time)	Selects dwell and slew time (time is in seconds). Dwell time is the time the unit remains locked on a particular frequency before stepping to the next frequency. Slew time is the time the unit spends sweeping from one frequency to the next, regardless of the establishment of phase-lock. The actual time of the Dwell T parameter is approximately ± 10% of programmed value, + 5 msec.
F INC (Frequency Increment)	Selects the frequency increment of each step in the sweep/step mode.
HIGH F (Highest Frequency)	Selects the high parameter of a frequency sweep/step mode.
LOW F (Lowest Frequency)	Selects the low parameter of a frequency sweep/step mode.
EDIT	When the EDIT pushbutton is depressed, the displayed register becomes enabled to receive single digit changes to the display readout. Example: Display reads 13.7500. The operator desires to change the readout to 13.5100. The operator presses the EDIT pushbutton, then presses the 3 on the keyboard. As the 3 is pressed, an E will appear in the third digit location in lieu of the 3. Now, the operator keys-in a 5. The 5 is entered into the readout and the E moves to the next digit on the right. Once again, the operator keys-in the number 1 and the readout now reads 13.51E0. At this point, the operator (having made the required changes to the display readout, presses the keyboard's ENT pushbutton. The corrected data is now entered into the appropriate register as permanent data.

Table 2-1. Front and Rear Panel Controls and Indicators (Continued)

CONTROL/INDICATOR	FUNCTION
	The CLR key may be used at any time during the editing to revert back to the original data stored in the register. NOTE: When editing digit #2, a blank will appear instead of the E.
Mode Select Switches:	The Mode Select Switches determine what mode of operation the unit is in.
STOP/STEP	A momentary contact switch used to single step the unit's frequency output in the value F INC; either up or down. While the unit is taking the required step, the unit's output frequency is flashed on the display. This switch is also used to stop a frequency sweep.
START SWEEP	A momentary contact switch that is used to start a frequency sweep. The sweep begins at the value of F OUT and steps at the value of F INC. Nominal rate of the dwell mode is 1 DWELL T plus PHASE-LOCK TIME. These rates remain constant until a frequency outside the LOW F to HIGH F parameters is reached, where the alternate limit is loaded into the F OUT register and the sweep-steps continue producing a sawtooth effect of time-versus-frequency.
UP/DOWN	This pushbutton switch selects the UP mode when it is in its OUT position and selects the DOWN mode when in its IN position. This switch can be changed at any time during a sweep, causing the sweep to reverse its direction without stopping the sweep.
DWELL/SLEW	Selects DWELL mode of operation when in its OUT position and the SLEW mode when in its IN position.
LOCAL/REMOTE	Pushbutton switch/lamp selects either LOCAL or REMOTE modes of operation. When LOCAL is selected, the front panel keyboard is in control. When REMOTE is selected, external commands are applied to the rear panel REMOTE INPUT connector; thus, remote control operation.

Table 2-1. Front and Rear Panel Controls and Indicators, (Continued)

CONTROL/INDICATOR	FUNCTION
STATUS	Dual indicator lamps. Illuminates green whenever the synthesizer signal is LOCKED. Illuminates red when signal is NOT LOCKED.
POWER	This switch controls the main AC power to the unit. NOTE: The unit has modules that use heater elements. These elements are always on regardless of the POWER switch's status; ON or OFF. However, when the unit has been disconnected from an AC power source, the unit will require a warm-up period when its reconnected to an AC input.
INT/EXT (Internal or External)	Provides an internal or external 5 MHz reference signal.
LOCK/UNLOCK	Normally in the LOCKED position. In the UNLOCK position, this switch couples a fine-tuning voltage to the YTO.

Table 2-2. Front and Rear Panel Connectors

CONNECTOR	LABEL	FUNCTION
(Front)	REF OUTPUT	OSM connector. Output for the 1.7 to 19.7 GHz reference harmonic signal generated at the YIG-Tuned Harmonic Multiplier A1. This signal is coupled over to the WJ-1251-xx RF Source.
(Front of RF Source)	REF INPUT	OSM connector. Receives the 1.7 to 19.7 GHz reference harmonic signal from the REF OUTPUT connector on the mainframe front panel.

Table 2-2. Front and Rear Panel Connectors (Continued)

CONNECTOR	LABEL	FUNCTION
(Front of RF Source)	RF OUTPUT	Type N connector. Output for the WJ-1250A Frequency Synthesizer RF signal.
J1 (Rear)	REMOTE INPUT	A 50 pin connector. Provides external control interfacing to the WJ-1250A.
J2 (Rear)	5 MHz IN/OUT	BNC connector. When the S2 switch (INT/EXT) is in the INT position, an internal 5 MHz reference frequency is available at this connector. When the switch is in the EXT position, an external reference can be applied to the connector.
J3 (Rear)	FM IN	BNC connector. When the S3 switch (LOCK/UNLOCK) is in the UNLOCK position, a voltage can be applied to this input for fine-tuning the YIG oscillator. The output of the Synthesizer is not phase-locked. S3 is normally in the LOCKED position.
J4 (Internal)	N/A	A 33 pin connector. Provides electrical interfacing between the Synthesizer and the RF Source.
J5 (Rear, Ext. Power IN)		A nine-pin connector. Provides a means of supplying additional power to the mainframe when used in conjunction with the WJ-1251-9 or -10 RF Sources.

2.3 OPERATION

When operating in the LOCAL mode, the 16-button keyboard provides a fast and convenient method for selecting frequency with 100 kHz resolution. When the keyboard buttons are pressed, the selected frequency is displayed on a six-digit LED readout. The

frequency changes to a new value when the ENT keyboard button is pressed. When entering a new frequency, it is not necessary to set controls to blank out non-significant digits. Zeros are added automatically. To select 13 GHz, the 1, 3, and ENT buttons are the only buttons pressed. The displayed and actual frequency is 13.0000 GHz.

A flashing display indicates that an out-of-range frequency has been selected. To avoid the possibility of taking data at an incorrect frequency, the output is held at the original frequency until the correct frequency is entered. The erroneous selection is cleared from the readout by depressing the CLR keyboard button. Remote digital selection of frequency is accomplished by way of rear panel (REMOTE INPUT) connector, J1.

NOTE

Parallel BCD, Standard Computer, Standard Bus, and Serial interfaces are available for meeting virtually any programming requirement.

The 1250A's RF output signal may be frequency modulated by an external FM source through the rear panel FM IN connector (J3) when the S3 switch is set to the UNLOCK position. Under this condition, the output is no longer phase-locked. The status indicator on the front panel will indicate that the signal is unlocked.

5 MHz IN/OUT connector (J2) is located on the rear panel, and is provided to accept an external 5 MHz reference. The Reference Select switch (S2) must be in the EXT position when the external 5 MHz reference is used and in the INT position when the internal 5 MHz reference is available at J2 as a TTL signal.

Section 3

THEORY OF OPERATION

3.1 SCOPE OF SECTION

The purpose of this section is to provide a general and detailed theory of operation for the WJ-1250A Frequency Synthesizer. An overall block diagram is included. Schematic diagrams for all circuit cards described are provided in Section 5.

3.2 FUNCTIONAL DESCRIPTION

The basic components which comprise the WJ-1250A Frequency Synthesizer are the WJ-1250A mainframe, and any one of a number of WJ-1251-xx microwave RF plug-in sources. The WJ-1250A may be programmed either manually from the front panel keyboard or remotely by digital command inputs; via rear panel connector J1. The WJ-1250A is capable of providing a spectrally pure output signal by phase-locking a YIG tuned fundamental oscillator, in the RF source, to an oven-enclosed reference oscillator in the mainframe.

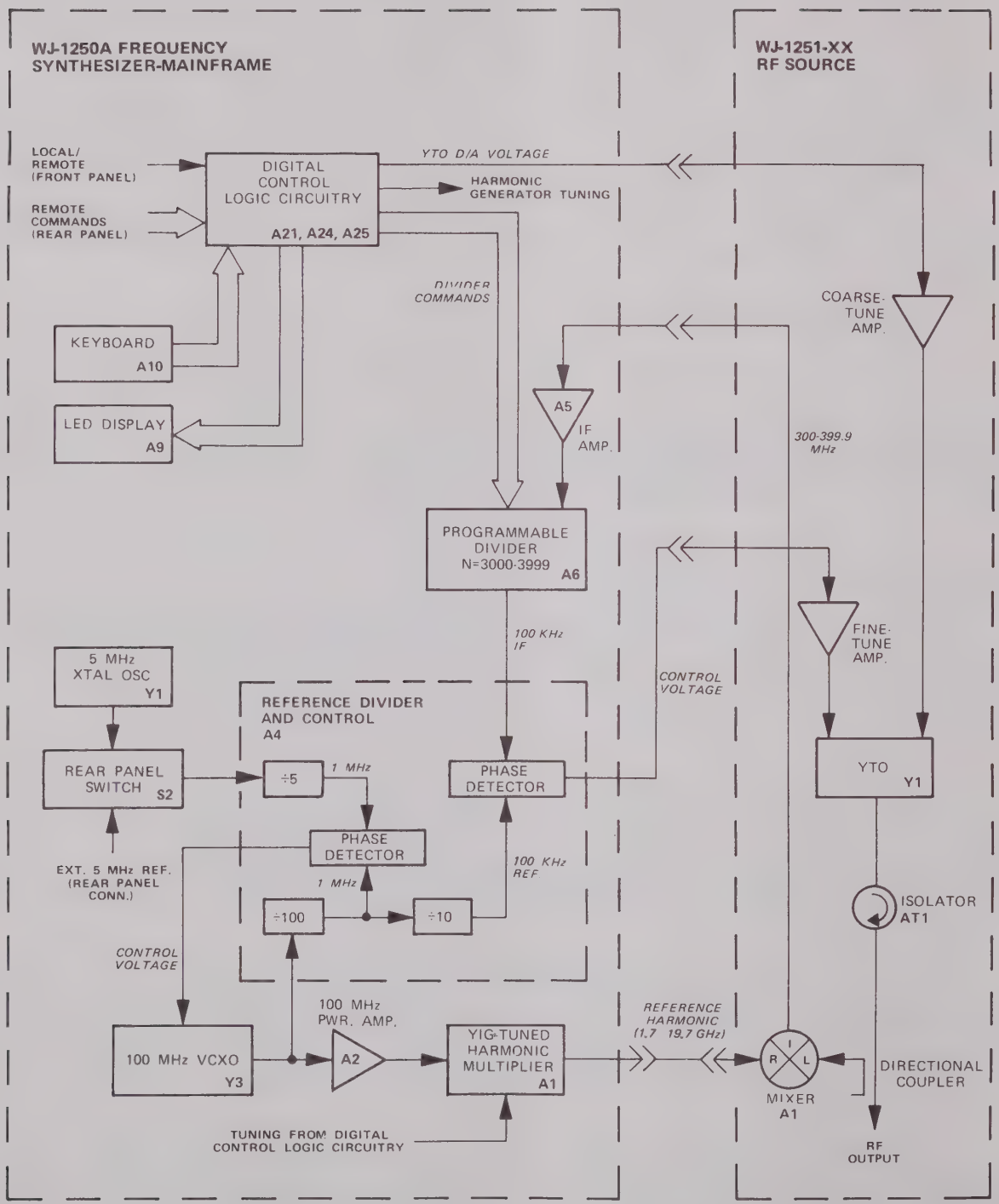
Figure 3-1 is a block diagram of the WJ-1250A Frequency Synthesizer. The general theory of operation follows.

Local and remote commands are processed by the Digital Control Logic Circuitry which is comprised of: Harmonic Generator Driver A21; Z-80 Controller A24; Z-80 I/O Extender A25. This circuitry translates keyboard or remote connector programming commands into the proper format to control LED Display A9, Programmable Divider A6, and Reference Divider and Control Assembly A4, for tuning the YIG-tuned devices.

Z-80 Controller A24 and Z-80 I/O Extender A25 receive and process all remote and local commands. The Z-80 Controller is a microprocessor-based circuit which provides not only a versatile intelligent interface, but also a cost effective general interface for applications requiring unique interface capabilities. Because the WJ-1250A is a microprocessor-based unit, it is particularly useful when used in automatic test systems where the main controlling component is a minicomputer or calculator.

Frequency accuracy is determined by a 5 MHz signal from either an internal 5 MHz XTAL OSC Y1, or an externally supplied 5 MHz reference. The 5 MHz signal is applied to the Reference Divider and Control Assembly A4, via rear panel Switch S2, and is divided by five. A 100 MHz signal from 100 MHz VCXO Y3, is also applied to A4 and is divided by 100. The two resulting 1 MHz signals are applied to a phase detector. The detector output drives the tuning control input (Control Voltage) of the 100 MHz VCXO, thus, closing the phase lock loop.

The output of Y3 is amplified to about 1 watt at Amplifier A2, and applied to the YIG Tuned Harmonic Generator A1. Upon command from the Digital Control Logic Circuitry, the harmonic generator is tuned to select the particular harmonic whose frequency is 300 to 399.9 MHz below the desired synthesized frequency. The selected harmonic, 1.7 to 19.7 GHz, is then supplied as a reference frequency to the RF source.



77-L-267

Figure 3-1. WJ-1250A Frequency Synthesizer, Block Diagram.

The YTO D/A voltages from the Digital Control Logic Circuitry are applied to YIG Tuned Oscillator (YTO) Y1, in the RF source, via a Coarse-Tune Amplifier. This amplifier is used to drive Y1's primary control input, thereby, tuning the oscillator to approximately the desired output frequency (± 20 MHz). Other D/A voltages from the Digital Control Logic Circuitry also tune the harmonic generator to select the particular 100 MHz harmonic that is 300 to 399.9 MHz below the desired output frequency. Isolator AT1 is included in some RF sources to ensure that oscillator performance is not seriously degraded by substantial load mismatches.

The IF signal produced by Mixer A1, in the RF source, is nominally within the 300 to 399.9 MHz range. This IF signal is amplified at IF Amplifier A5 within the mainframe and then applied to 500 MHz Programmable Divider A6. The divide ratio of A6 is programmable from 3000 to 3999. When Y1 (in the RF source) is properly locked, the divider output frequency is 100 kHz. The 100 kHz IF from A6 is applied to a phase detector in A4 and is frequency and phase compared to a 100 kHz reference derived from Y3. The phase-error control voltage is then applied to the input of the Fine-Tune Amplifier within the RF source, thus closing the frequency control loop. The action of the fine-tune control forces the 100 kHz IF to be in phase with the 100 kHz reference signal, thereby locking the microwave oscillator at precisely the desired frequency.

The preceding paragraphs have discussed the general theory of operation of the WJ-1250A Frequency Synthesizer mainframe and the WJ-1251-xx RF source. The following example illustrates some specific commands and operations that occur during the synthesis of a specified microwave frequency.

Assume that a WJ-1251-4 RF Source (4.0 GHz to 8.0 GHz) is installed in the unit, and a desired frequency of 6.7913 GHz is selected. In order to synthesize the required frequency, the following conditions are established:

a. The mainframe YIG-Tuned Harmonic Multiplier is programmed to the 64th harmonic of 100 MHz (6.4 GHz).

b. The YTO D/A Voltage tunes the YTO output to approximately the desired frequency (typically within ± 15 MHz for this frequency band).

c. The resulting mixer IF is nominally 391.3 MHz prior to phase locking.

(IF = 6791.3 MHz - 6400.0 MHz).

d. The Programmable Divider is set to divide the resulting IF by 3913, thereby producing a nominal 100 kHz output signal.

e. The 100 kHz IF is phase compared to the 100 kHz reference in A4 and the output of the Phase Detector circuit is then applied to the Fine-Tune Amplifier.

Thus, the frequency control loop is closed. By forcing the two 100 kHz signals into phase-coincidence, the feedback loop locks the RF output frequency at precisely the programmed value (to within the accuracy of the basic 5 MHz reference for the synthesizer).

3.3 DETAILED CIRCUIT ANALYSIS

The following paragraphs provide a detailed analysis of each circuit card assembly within the WJ-1250A Frequency Synthesizer. Each description is referenced to the appropriate schematic diagram and supported, where necessary, with simplified block diagrams.

3.3.1 Z-80 CONTROLLER A24

The Z-80 Controller A24 (Figure 5-8) is a general purpose microprocessor system built around the Zilog Z-80 CPU which is a third generation microprocessor using n-channel MOS technology. The Z-80 CPU is designed to work directly with a minimum number of memory and peripheral support chips, a single +5 Volt supply, and a single-phase clock. The clock frequency of approximately two MHz permits instructions to be executed in two to nine microseconds. Since design changes to microprocessor-based systems are simply a matter of modifying the control program (in contrast to redesigning and laying the logic afresh) the Z-80 Controller is also used in various other Watkins-Johnson products. Figure 3-2 is a block diagram of the Z-80 Controller A24.

As in any microprocessor system, the circuitry of the Z-80 Controller consists of a CPU chip, a random-access memory (RAM) for temporary storage of data, a read-only memory (ROM) for storing the system's program parameters, and a set of input/output (I/O) interface chips; Figure 3-2.

The CPU is in the heart of the system. Its function is to obtain (fetch) instructions from memory and perform the desired mathematical, logical, or transfer operation. The CPU is designed around the popular parallel data bus concept so that all memory and peripheral interface chips simply hang on the CPU's eight bidirectional data lines. Internal to the CPU are eighteen 8-bit registers and four 16-bit registers that are accessible to the programmer. All CPU registers are implemented using a static RAM. The CPU uses a single-phase clock generated by voltage-controlled oscillator (VCO) U8 for timing its various functions. The clock is factory set for a frequency of approximately 2 MHz.

The CPU generates signals to control the use of the board's 8-bit data bus for data input/output, program memory input, or random-access memory. The Z-80 CPU takes five control inputs and generates six control outputs as listed in Table 3-1.

Table 3-1. CPU I/O Lines

CONTROL	DESCRIPTION
A_0 through A_{15}	Output. A 16-bit address which defines a memory or input/output location.
$\overline{IORQ}$	Output. A negative-true line which indicates the address lines and data bus are being used for an input or output operation on a peripheral device.

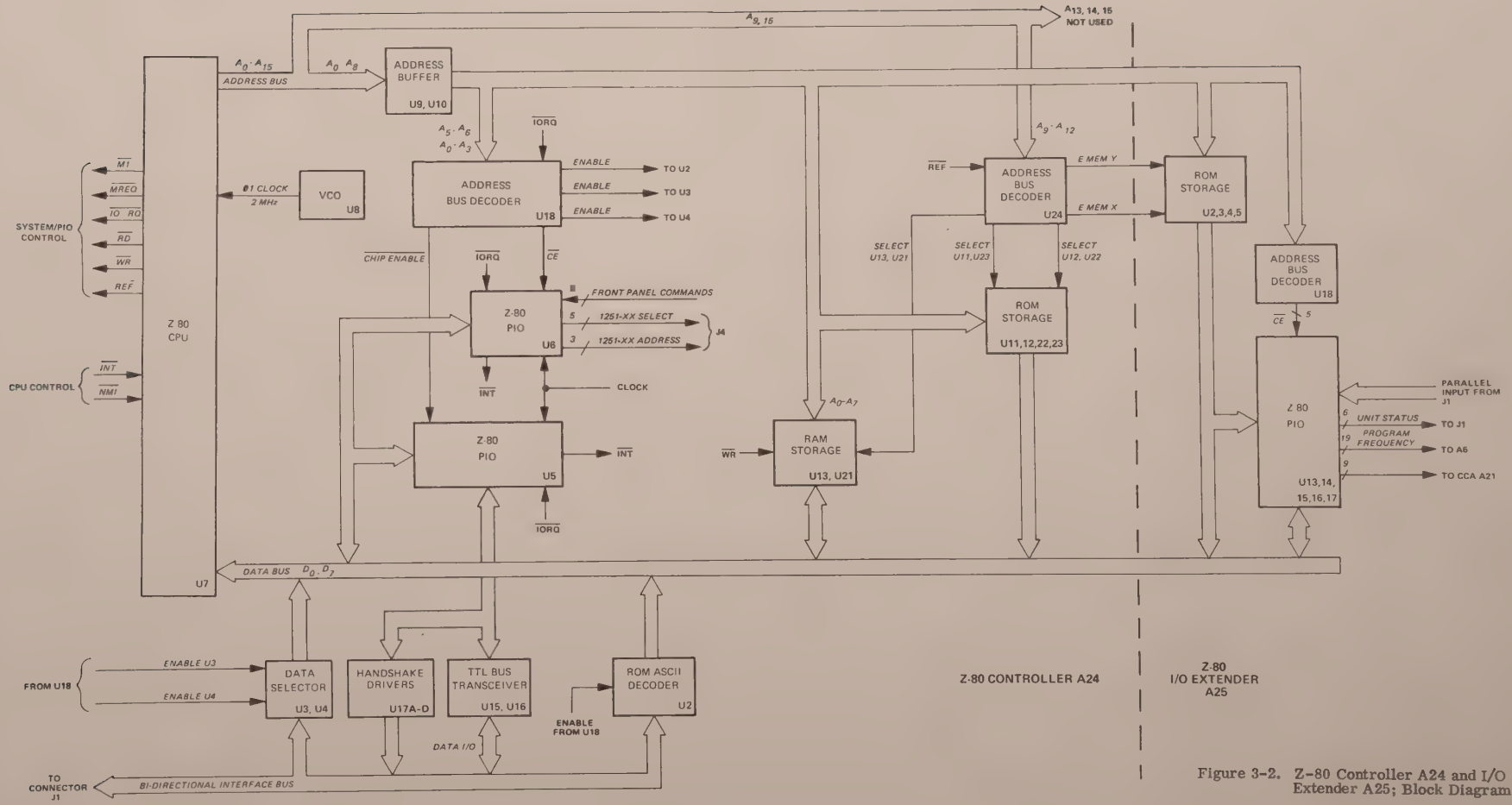


Figure 3-2. Z-80 Controller A24 and I/O Extender A25; Block Diagram.

77-L-268

Table 3-1. CPU I/O Lines (Continued)

CONTROL	DESCRIPTION
$\overline{\text{MREQ}}$	Output. An active low line which indicates the address lines and data bus are being used for memory input or output.
$\overline{\text{M1}}$	Output. A timing signal which indicates the CPU is in an operation (OP) code fetch mode. This is the first of two to sixteen machine cycles which comprise a complete instruction cycle for the CPU.
$\overline{\text{RD}}$	Output. An active low signal which indicates the data bus is being used as an input to the CPU.
$\overline{\text{REF}}$	Output. An active low signal which indicates the address lines are being used to refresh dynamic RAM. (This signal is not necessary for use by the static RAM. Thus, it is used to disable any memory selection by One-of-Eight Decoder U24.)
$\overline{\text{WR}}$	Output. An active low signal which indicates the CPU is using the address lines and data bus to write data into memory for storage purposes.
$\overline{\text{BUSRQ}}$	Input. An active low input which disables the CPU's use of the data bus. (Not used in this configuration.)
CL	Input. CPU clock input (approximately 2 MHz).
$\overline{\text{INT}}$	Input. A firmware maskable interrupt used by the peripheral devices to stop normal operation of the CPU and service the peripheral device.
$\overline{\text{WAIT}}$	Input. An active low signal which suspends all CPU activity. (Not used in this configuration.)
$\overline{\text{NMI}}$	Input. Non-maskable interrupt request. Has higher priority than INT.

The programmable input/output (PIO) circuits consist of U5 and U6. These ICs are Zilog Z-80 PIOs, which are software programmable as to their input/output functions. During the unit's power-up cycle, these ICs are commanded by the CPU as to which of the I/O ports (A_0 through A_7 and B_0 through B_7) are to be used as an input or an output, whether the handshake lines (RDY and STB) are to be used or ignored, and if any single or multiple combination of highs or lows on the I/O ports will cause an interrupt.

The dedicated I/O circuits consists of the circuitry used by the Z-80 Controller to interface with a remote control device using the IEEE 488-1975 Standard Digital Interface. These circuits consist of the following:

U2	A read-only memory used to decode ASCII information into one of 16 codes used by the unit for a quick decode of universal commands and unique unit commands.
U3, U4	Tri-state data selectors used to monitor interface bus commands and input the interface bus data lines to the unit.
U15, U16	Interface bus transmitter/receiver used to communicate data and commands with the remote device.
U1A, U1B	One-shots used to generate interrupts to the CPU, via PIO U5, for quick reaction to an interface bus command of ATN (attention) or IFC (interface clear).
U14A, B, and D	NAND gates used to disable any interface bus transmission when an ATN or IFC is sensed by the one-shots.
U17A thru D	Open collector OR gates for interface bus Talk or Listen handshaking and control of the unit's SRQ (service request).
Q1	A transistor, controlled by the ATN one-shot, and used to bring the NRFD line low when an ATN is sent over the bus. (This allows the microprocessor to set up its control lines before servicing the interface bus.)

Circuits U19 and U20 comprise the user definable I/O. U20 is a 10-segment toggle switch which can be set to control various unit parameters, and U19 is a diode array. The upper five settings of U20 are used for various modifications of special unit functions such as calibration and maintenance, or for special user definable interfaces which are field changable. The lower five switch positions control the unit's IEEE 488-1975 Standard talk and listen addresses.

3.3.2 Z-80 I/O EXTENDER A25

The Z-80 I/O Extender A25 (Figure 5-9) consists of Address Bus Decoder U8, ROM devices U2 through U5, PIO chips U13 through U18, RS Latches U6, Drivers U10 and U11, and Digital-to-Analog Converters U1 and U19. Figure 3-2 is a block diagram of the Z-80 I/O Extender A25.

As the name implies, this circuit is an extension of the Z-80 Controller (Figure 3-2). ROMs U2 through U5 store programmed instructions and data constants that can be fetched when addressed. Two enable outputs from the Z-80 Controller ($\overline{\text{E MEM X}}$ and $\overline{\text{E MEM Y}}$) permit the selected ROMs to output data to the data bus.

Address Bus Decoder U8 is a one-of-eight decoder which selects the active PIO for input or output. The Y0 through Y5 outputs enable PIOs U18 through U13, respectively. The Y6 output enables D/A converter U1.

U1 is an 8-bit straight binary D/A Converter with an input storage register. The Y6 output from U8 is applied to pin 16 (CLOCK input) of U1 via inverter U9. With the clock input high, digital inputs to U1 are converted to analog voltage and will follow changes in the inputs.

With the clock low, the information present at the digital inputs is retained and the analog output will not change with changes in digital inputs. The output from U1 ranges from 0 to +9.961 Volts and is provided at pin 7 (Table 3-2).

Table 3-2. D/A Converter U1 I/O

INPUT PINS								OUTPUT V
5 (MSB)	4	3	2	15	14	13	12 (LSB)	PIN 7
0	0	0	0	0	0	0	0	0.000
1	0	0	0	0	0	0	0	5.000
1	1	0	0	0	0	0	0	7.500
1	1	1	0	0	0	0	0	8.750
1	1	1	1	0	0	0	0	9.375
1	1	1	1	1	0	0	0	9.687
1	1	1	1	1	1	0	0	9.844
1	1	1	1	1	1	1	0	9.922
1	1	1	1	1	1	1	1	9.961

When PIO U18 is selected, digital information is supplied to D/A Converter U19. This device accepts 4-digit complementary BCD digital input codes and provides an output current of $\pm$1 mA. This output is amplified by Current Driver U12. Control of the gain is provided by potentiometers R1 and R2. The most significant bit into U19 is applied to pin 1 and the least significant bit to pin 16. A ladder resistor network and current switches are used by U19 to provide the analog output.

Circuit U6 is a quad RS latching device which maintains a stable output for any combination of logic inputs, and circuits U10 and U11 are high-voltage, high current, open collector drivers.

3.3.3 HARMONIC GENERATOR DRIVER A21

Harmonic Generator Driver A21 (Figure 5-7) accepts digital tuning commands from the Z-80 I/O Extender A25 and provides the ultra-precise tuning and bias currents, which control the programming of YIG Tuned Harmonic Multiplier A1. Figure 3-3 is a block diagram of Harmonic Generator Driver A21.

The entire tuning range of YIG Tuned Harmonic Multiplier A1, is broken up into seven distinct band segments by decoding circuitry in Programmable Read Only Memory (PROM) chips, U17 and U18. These PROM's are programmed at the factory in order to linearize the tuning characteristics of individual harmonic multipliers and thus, the band segments may vary from one unit to another. A typical band segment breakdown is given in

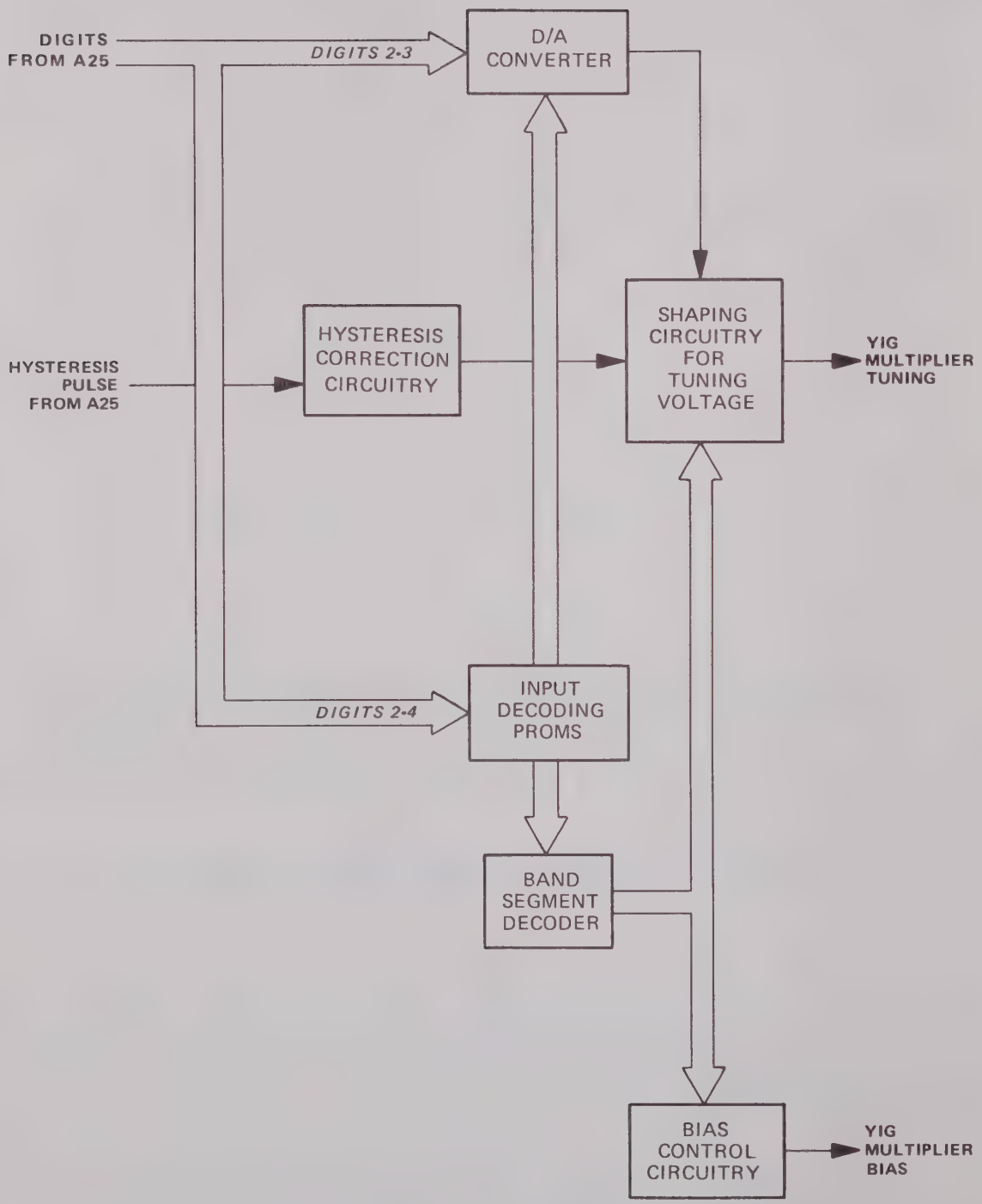


Figure 3-3. Harmonic Generator Driver A21, Block Diagram.

the first two columns of Table 3-3. Associated with each of the seven segments (A through G) are three potentiometers (R1, R2, and R3) which control tuning and bias currents to the harmonic multiplier. These are called out for a typical unit in the last three columns of Table 3-3.

Table 3-3. Typical Tuning Adjustment Settings

Freq. Range (GHz)	Band	Start Adjust	Gain Adjust	Bias Adjust
0.00-0.94	A	R2A	R1A	R3A
0.95-1.94	B	R2B	R1B	R3B
1.95-3.94	C	R2C	R1C	R3C
3.95-7.94	D	R2D	R1D	R3D
7.95-9.99	E	R2E	R1E	R3E
10.00-13.94	F	R2F	R1F	R3F
13.95-19.99	G	R2G	R1G	R3G

Programming commands from the Z-80 I/O Extender A25, are applied to D/A Converter U10 and PROM's U17 and U18. D/A Converter U10, looks at eight lines (Digits 2 and 3) from the Z-80 I/O Extender and supplies an analog output voltage which is proportional to the digital input. PROM U18, looks at eight lines (Digits 3 and 4) and determines the following information: If Digit 4 is greater than or equal to five (50 MHz), then Q4 goes high and Q1 goes low. If Digit 3 is greater than or equal to four (400 MHz), then Q2 goes high. If Digit 3 is equal to nine (900 MHz), then Q3 and Q2 both go high. If these conditions are not met, then the outputs of U18 are in their complementary states. PROM U17 looks at five lines from the program register (Digit 2 and 10 GHz bit) and three lines which are outputs of U18. U17's primary job is to decode the input frequency into one of the seven band segments. Outputs Q1, Q2, and Q3 represent a binary number from one to seven and are applied to Binary to Decimal Decoder U2, and to Analog Switch U1, via U17. Output Q4 goes high if the programmed frequency is greater than or equal to 10 GHz.

Binary to Decimal Decoder U2, provides an active low signal on one of its seven output pins depending on the programmed frequency. All of the other outputs are high. These outputs are used to enable or disable Analog Switches U3 through U6, and U8. Analog Switches U3 and U4, are used to switch one of seven pots, (R2A through R2G), into the inverting input of OP AMP AR2. Analog Switches U5 and U6, switch the corresponding one of seven band segments. Potentiometers R2A through R2G, are used to adjust the start (offset) of the tuning voltage in each segment. Analog Switch U8, is used to allow an additional voltage to be applied to AR2 when the programmed frequency is above 10 GHz. Below 10 GHz, switch position 3 is enabled. At 10 GHz or above, switch position 4 is enabled. This is because D/A Converter U10 does not look at the 10 GHz bit, and it is necessary to sum an additional tuning voltage into AR2 in order to cause Harmonic Multiplier A1 to tune to its harmonics. (At 0 GHz, the D/A output voltage is 0 Volts).

Comparators U12, U13, and U14, as well as Oneshot U11B, make up the hysteresis correction circuitry. Because Harmonic Multiplier A1 is a YIG tuned device, it exhibits hysteresis; i.e., the output of A1 depends not only on the programmed frequency, but also on the previous programmed frequency. Specifically, the output of A1 will normally differ depending on whether the frequency is approached from above or below. The hysteresis circuitry ensures that the new frequency is always approached from below.

NOTE

U12, U13, and U14 are disabled in the version described in this manual. When a new frequency is about to be entered, it is compared with the present (old) frequency. If the new frequency is less than the old frequency, a hysteresis pulse is generated by the Z-80 microprocessor circuitry and applied to pin 47 of A21.

The Q output of U11B causes U2 to go to an invalid state, which forces all seven of the (used) outputs into the high state. This effectively removes all 14 pots (R1A-R1G and R2A-R2G) from the circuit. The Q output disables U9A and U9D and enables switch position two of U8, effectively putting the inputs of both AR2 and AR4 at ground. The result is that the tuning voltage (and thus, the tuning current) for Harmonic Multiplier A1, goes to zero Volts. This tunes the YIG device down to the bottom of its range. When Oneshot U11B times out, the multiplier is released to tune upward towards its new final frequency. No hysteresis correction is generated if the new frequency is already higher than the present frequency.

Oneshot U11A, is used to generate the Stretched Load pulse. Each time the ENT key is depressed to load a new frequency, Z-80 I/O Extender A25 generates a Load Pgm Reg pulse. This narrow pulse is applied to U11A and the Q output is used as a Stretched Load pulse to activate the Hold-off flip-flop on A25. When the Hold-off line goes high (indicating that a new frequency was just entered) the output of NAND gate U9B goes low. This signal is used to operate Analog Switch U7, which effectively removes C19 from the circuit during switching time. Capacitor C19 is used to improve the noise performance of the output signal; however, its presence tends to prevent AR2 and Q1 from slewing rapidly to the new frequency. As the Synthesizer acquires lock at the new frequency, the Lock-line resets the Hold-off flip-flop on A25, and the Hold-off signal goes low, which reverses Analog Switch U7, and puts C19 back into the circuit. Resistors R37 and R38, and Diodes CR3 and CR4 are used to prevent pulling the output when Capacitor C19 is reinstalled by U7.

The circuitry consisting of AR1, Q2, R3A through R3G, VR1, CR1, and CR2 are used to provide the proper bias voltage to Harmonic Multiplier A1. A negative voltage is applied (through one of the R3A through R3G pots) to the inverting terminal of AR1. The positive output is applied to Emitter Follower Q2 in order to boost the bias current. The positive bias voltage is then clamped by CR1 and CR2 to about 1.3 Volts to prevent damaging the harmonic multiplier.

The reference voltage for the entire board is obtained from AR6, which is an ultra-stable zener diode. The diode is maintained at a constant temperature by an internal proportional heater and the output at pin two of AR6 is nominally about seven Volts. OP AMP AR5 and Potentiometer R16, are used to make the reference voltage at TP4 equal to 10.000

Volts. This voltage is used as a reference for D/A Converter U10, and is also used to bias AR2 to the proper operating voltage.

Oneshot U16A, Inverters U15D, U15E, and U15F, as well as NAND gate U9C, are used to remove transients from the lock-signal during switching. This will prevent the Hold-off signal from reinserting Capacitor C19 too soon.

As YIG Tuned Harmonic Multiplier A1 is the heart of the entire Synthesizer, the tuning adjustments on this board are most critical and the board was designed to be fully temperature compensated using precision resistors in critical locations.

Table 3-4 provides typical voltages found at the various test points on A21.

Table 3-4. Typical Voltages

TEST POINT	VOLTAGE
TP1	0.25 Volts/GHz
TP2	0.00 Volts
TP3	0.50 Volts/GHz
TP4	10.0 Volts

3.3.4 REFERENCE DIVIDER AND CONTROL A4

Reference Divider and Control Assembly A4 (Figure 5-3) receives a 100 MHz Ref Input signal from 100 MHz VCXO Y3, divides it down to 100 kHz, then frequency and phase compares it against the 100 kHz IF Input signal from AGC IF Amplifier A5. Figure 3-4 is a block diagram of Reference Divider and Control Assembly A4.

The 100 MHz Ref Input is applied to J2, coupled through a factory selected resistor pad, and applied to pin 12 of Divide-by-Ten Counter U1. A 10 MHz TTL output is provided at pin 7 and applied to pin 14 of Divide-by-Ten Counter U3. With a 1 MHz signal at pin 11 of U3, the upper portion of U3 is effectively dividing by two and applies a 5 MHz signal to pin 18 of J1 (normally not used). The 1 MHz signal at pin 11 of U3 is coupled to pin three of Phase Detector U4, and pin 14 of Divide-by-Ten Counter U7. In normal operation, A is jumpered to C and the 100 kHz signal at pin 11 of U7 is coupled to pin two of Vernier Multiplexer U8, and to the 50/100 kHz Out J3.

In normal operation (A is jumpered to C) the 100 kHz signal passes through U8 to pin four and is applied to pin one of Phase Detector U9.

U9 compares the 100 kHz reference signal at pin one against the 100 kHz IF at pin three. The 100 kHz signal at pin three is applied via the High Speed Programmable divider A6 at 100 kHz IF Input J5. The output pulse width duty cycle at pins two and 13 of U9 are proportional to the phase and/or frequency error between the reference and variable inputs at pins one and three. These varying pulse width signals are applied to pins four and 11 of U9, called the level translator. This pulse of information is summed, integrated, and amplified by Amplifier AR12. The output of AR12 is an RF loop correction voltage proportional to the phase and/or frequency error of the two 100 kHz signals appearing at the inputs of U9. The

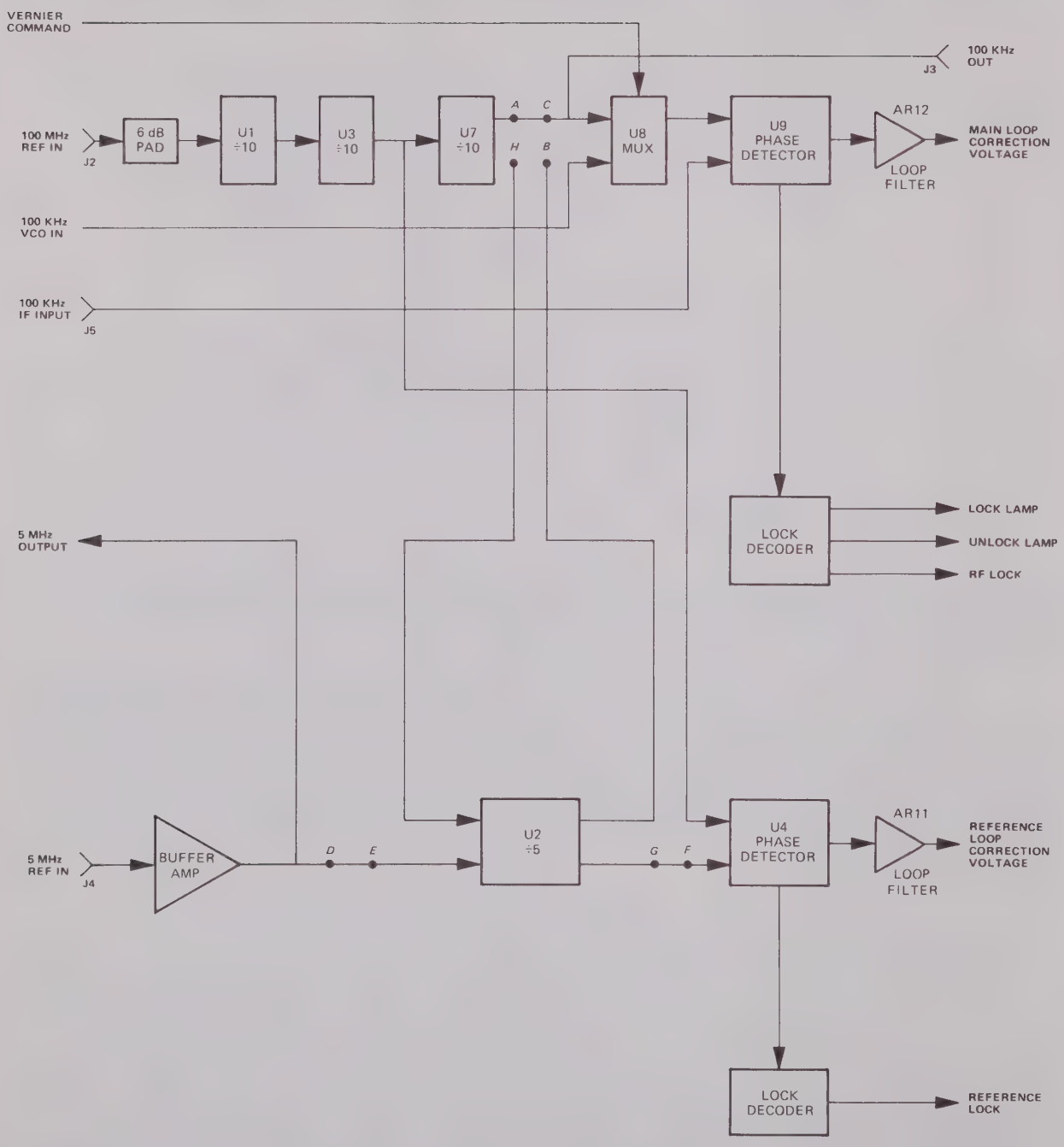


Figure 3-4. Reference Divider and Control Assembly A4, Block Diagram.

RF loop Correction Voltage at pin 13 of J1 is used to fine tune YTO Y1 (in the RF source) to the proper frequency thus, closing the loop and establishing phase lock.

The circuitry consisting of Resistors R26 and R27, Capacitors C15 and C16, Oneshot U10, AND gate U5, and transistors Q1 and Q6 are the decoding circuitry for the LOCK/UNLOCK lamp on the front panel.

The series of 100 kHz pulses from pins two and 13 of U9, have a duty cycle directly proportional to the loop tuning error. The phase detector provides very narrow pulses when it is approaching lock. The pulses are integrated by the R26, C15, R27, and C16 low pass filter network, and applied to pins one and two of Oneshot U10, and pins 10 and 11 of AND gate U5. This circuit discriminates against very narrow pulses. If the pulses are sufficiently narrow, pin six of Oneshot U10, remains high and enables U5. This in turn provides base drive for Transistor Q6. Q6 saturates and completes a ground return, which drives the LOCK lamp at pin eight of J1. If the pulses from Phase Detector U9 are not sufficiently narrow, indicating that the phase detector is not in lock, then pin six of Oneshot U10 goes low and disables U5. This in turn cuts off Transistor Q6 and saturates Transistor Q1, thus completing a ground return, which drives the UNLOCK lamp at pin 16 of J1.

Divide-by-Five U2, Phase Detector U4, and Amplifier AR11, comprise the Reference Loop Correction Voltage circuitry, and works in a manner similar to the RF Loop Correction Voltage circuitry.

The External 5 MHz Ref IN is applied to J4 and coupled to Transistor Buffer Q3. In normal operation, D is jumpered to E, and the buffered signal is applied to pin one of U2. A buffered signal is also applied to pin three of J1 as EXT 5 MHz OUT. (Normally not used in the WJ-1250A.)

The 5 MHz signal at pin one of U2 is divided by five, and a 1 MHz signal appears at pin 11 of U2. In normal operation, G is jumpered to F, and the 1 MHz signal at pin 11 is applied to pin one of Phase Detector U4. A 1 MHz signal is also applied to pin three of U4 from pin 11 of U3. Both 1 MHz signals, at pins one and three, are frequency and phase compared in the same manner as that of Phase Detector U9. The output pulses at pins five and 10 of U4 are summed, integrated, and amplified by Amplifier AR11. The output of AR11 is a reference loop correction voltage proportional to the phase and/or frequency error of the two 1 MHz signals appearing at the inputs of U4. The Ref Loop Correction Voltage, at pin one of J1, is used to close the reference loop and fine tune 100 MHz VCXO Y3 into phase lock with the 5 MHz oscillator.

The reference lock decoder circuitry consisting of Oneshot U6 and AND gate U5, is not used.

Potentiometer R43, connected to pins five and 10 of Phase Detector U9, biases U9 to a certan voltage in order to reduce 60 cycle noise that may be applied by the power supply. This adjustment is available on the outside of the Reference Divider and Control module.

Test Point 1 (TP1) is a means of checking the reference loop correction voltage and determining its value so that the oscillators can be adjusted for the center of their linear range. Normally the voltage is approximately four Volts at TP1, when the oscillators are phase locked.

3.3.5 500 MHz PROGRAMMABLE DIVIDER A6

500 MHz Programmable Divider Assembly A6 (Figure 5-4) consists of Programmable Read Only Memory (PROM) chips U6 through U9, High Speed Programmable Decade Dividers U2 through U5, High Speed ÷10/ ÷11 Prescaler U1, Emitter Coupled Logic (ECL) OR gates U10 and U11, and Transistor Q1. Figure 3-5 is a block diagram of 500 MHz Programmable Divider A6.

PROM's U6 through U9, are programmed at the factory and perform two functions. First, they decode the input digits from the program register located on the Z-80 I/O Extender A25, and second, they take the 9's complement of the decoded input digits.

The program register output digits 4, 5, 6, 7, and 8 (4 being the most significant digit and 8 being the least significant digit are applied to pins 3, 4, 5, 6, and 7 of PROM's U6 through U9 by way of J1. The Q outputs of the PROMs are applied to pins 7, 9, 10, and 11 of Programmable Decade Dividers U2 through U5. These dividers will divide by any number, 1 through 10, depending on what program is applied.

A 300 to 399.9 MHz RF Input is applied to J2, coupled through a six dB Pad, and is applied to pins 15 and 16 of High Speed ÷10/ ÷11 Prescaler U1. The output at pin four of Programmable Decade Divider U2, is coupled through the inverting portion of ECL OR gate U10 and applied to pin three of Prescaler U1. This command determines whether U1 is to divide by 10 or by 11.

The output at pin eight of U1 is applied to pins 13 (Clock Inputs) of Decade Dividers U2 through U5.

The data applied to pins 7, 9, 10, and 11 of Decade Dividers U2 through U5 from PROMs U6 through U9 is programmably selected such that the final IF is 100 kHz at pins six and seven of ECL OR gate U11.

Outputs at pins 14 and four of U3 are applied to pins 13 and four of ECL OR gates U10 and U11, and to pin six of U4, respectively. The output at pin four of U4 is applied to pins 10 and five of ECL OR gate U11. The output at pin four of U5 is applied to pin nine of ECL OR gate U11.

The 100 kHz IF signal at pin six of U11 is coupled through jumper points 30 and 31, and applied to pin 12 of ECL OR gate U11. The output at pin 14 of U11 is applied to the base of Transistor Q1. Part of U11 and Q1 comprise an ECL to TTL Translator. This translator converts the output pulses at pin six of U11, which are between three to four Volts, to a TTL signal which is between zero and four Volts at J3. The 100 kHz signal present at J3 is applied to Reference Divider and Control Assembly A4, to be compared against the 100 kHz Reference signal.

The resistor packs on the programmable divider board provide a pull-up function which is necessary to interface between TTL and ECL integrated circuits.

3.3.6 SIX-DIGIT LED DISPLAY A9

Six-Digit LED Display A9 (Figure 5-5) consists of Buffer Latches U1 and U3, a Multivibrator U2, Blanking PROM U4, 1-of-10 Decoder U5, and six display LED's (DS2 through DS7). Figure 3-6 is a block diagram of Six-Digit LED Display A9.

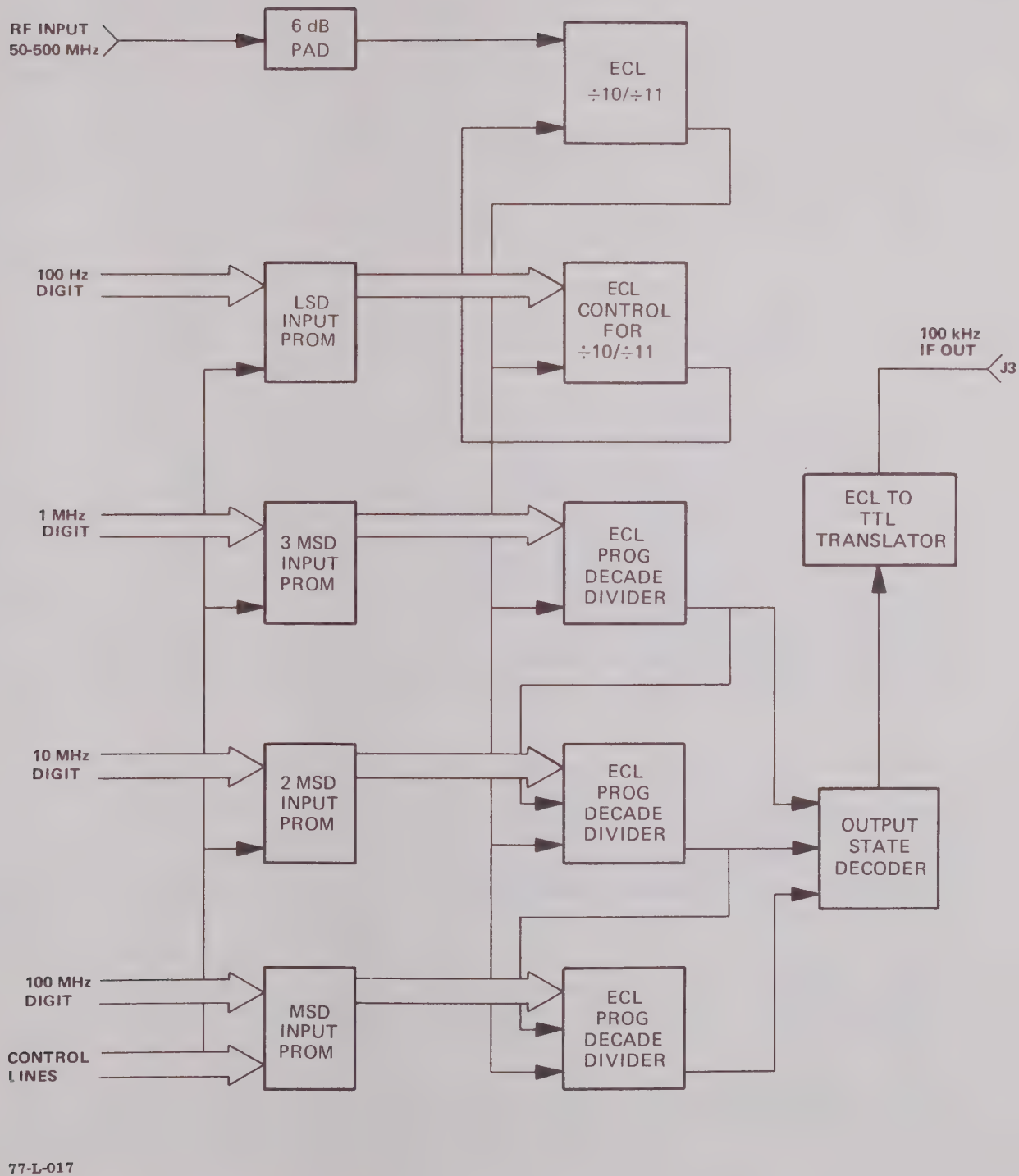


Figure 3-5. 500 MHz Programmable Divider A6, Block Diagram.

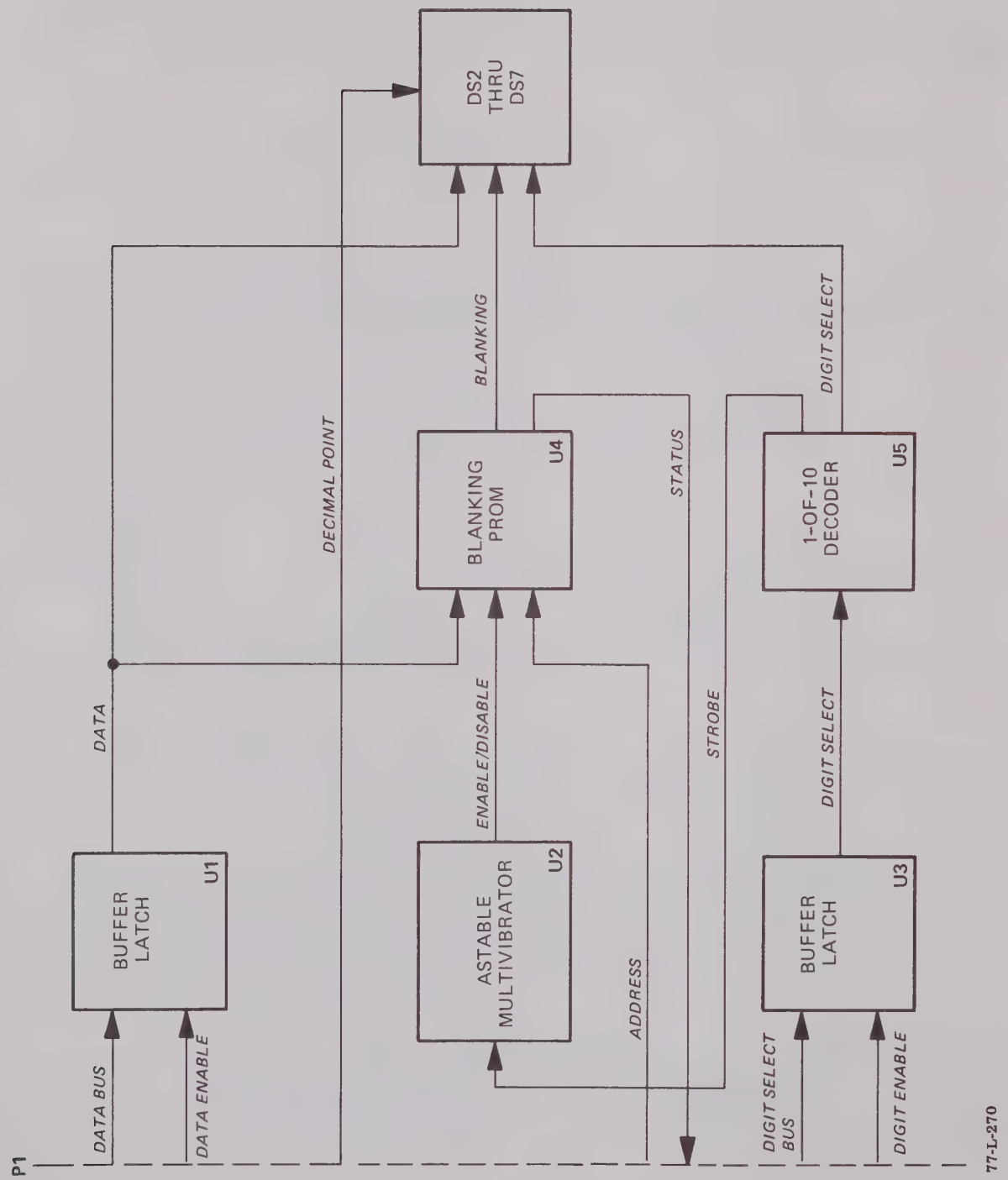


Figure 3-6. Six-Digit LED Display Assembly A9, Simplified Block Diagram.

The operation of the Display is based upon the Display's ICs which contain internal Data Latch Decode and Driver circuits. These circuits are activated by their respective enables that are being strobed low. The 1-of-10 Decoder U5, is used to select the digit whose data is being loaded. Buffer Latches U1 and U3, are enabled at the start of a display cycle and simply pass the digit selection and data; the numbers are latched into the Display IC. At the end of a display cycle, a code is latched into U1 and U3 defining the status of the display. The code latched at U3 is either a zero or a non-zero. A zero activates the reset strobe of the Astable Multivibrator U2, thus forcing its output to a low state. A non-zero allows U2 to oscillate, and thus alternately enable and disable the Blanking PROM U4. This action then causes all (except Digit 2) LED-displays to be turned off and on; indicates erroneous state of unit operation. The code latched at U1, is used by U4 to blank the unprogrammed digits during data entry. The ADDRESS 4 input to the unit, is used to blank the leading zero. The DECIMAL POINT input controls the presence of a decimal point on display digit two (DS3).

3.3.7 KEYBOARD ASSEMBLY A10

Keyboard Assembly A10 (Figure 5-6) consists of Decoder U1, the Keyboard, Oscillator and Debouncer U2, Binary Counter U3, Encoder U4, and PROM U5. Figure 3-7 is a block diagram of Keyboard Assembly A10.

Dual four-bit Binary Counter U3, counts from zero to seven in binary on its outputs; QA, QB, and QC. This binary count is decoded by 1 of 8 Decoder U1 into a single low at one of its eight outputs. When a Keyboard Key is pressed, this low is passed to Oscillator and Debouncer U2. U2 contains six shift registers, which are fed by inputs A, B, D, and F and clocked by an internal oscillator whose frequency is determined by 1000 pF capacitor C1. Internal to U2, are decoding networks on each of its shift registers. These decoding networks set and reset the latched outputs to the state of the respective input when the input has remained constant for four consecutive clock cycles. Since the same clock that is used on the shift registers is divided by 16 in the first stage of U3, the resultant count of seven applied to U1 is 16 times the length of one clock cycle at U2. Thus, when a Keyboard key is pressed, nothing happens until its appropriate column is strobed low by U1. This low is fed to the output of U2 when the keyed pulse has stopped bouncing long enough for four clock cycles to occur.

At this point, the 1-of-4 Encoder U4 performs two operations. The first is to set its EO output high and its GS output low, indicating that one or more of its four used inputs are active. When the EO output goes high, the first divide-by-sixteen counter of U3 is cleared; thus not allowing the second counter to be triggered, which holds the last count at U1. U1 is disabled from selecting a key during the last half of the divide-by-sixteen at its G2A input so that the clearing of the first counter's IQD output will not happen; the down stroke of the IQD is used to trigger the input of the second counter stage. This would change the count and cause an erroneous Keyboard reading.

The second purpose of U4 is to encode the four inputs to a two-bit binary output at A0-A1; the priority encoding of U4 selects the highest priority key if two keys have been pressed.

U5 is a programmable read-only-memory (PROM) which is addressed by both the column select (0 through 7 of U3) and the row select (0 through 3). The PROM has been factory programmed to output the data as shown in Table 3-5.

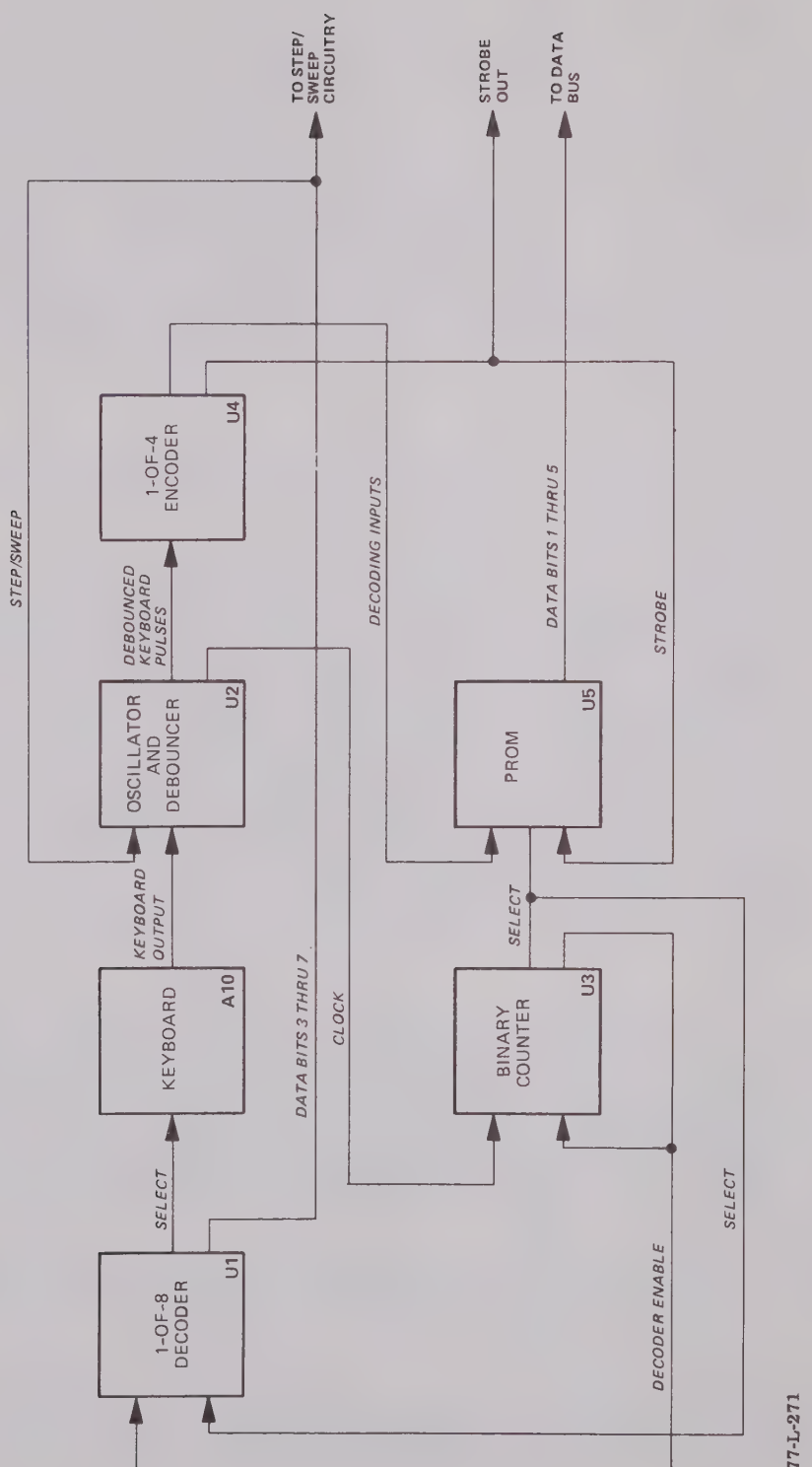


Figure 3-7. Keyboard Assembly A10, Simplified Block Diagram.

It should also be noted that the WJ-1250A front panel controls for sweep-start and sweep-stop/step are debounced and decoded by the Keyboard circuitry as column 4, row 2 and 3 respectively.

Table 3-5. Keyboard ROW and COLUMN Key versus Bit

Row	Column	Key	Bit 1-5 (Hex)
0	0	STO	11
1	0	RCL	12
2	0	ENT	13
3	0	RST	14
0	1	9	09
1	1	6	06
2	1	3	03
3	1	CLR	10
0	2	8	08
1	2	5	05
2	2	2	02
3	2	/./	17
0	3	7	07
1	3	4	04
2	3	1	01
3	3	0	00
2	4	SWEEP	16
3	4	STEP	15

Section 4

MAINTENANCE

4.1 SCOPE OF SECTION

This section outlines the alignment and troubleshooting procedures necessary for maintaining the WJ-1250A Frequency Synthesizer and associated WJ-1251-xx RF Sources. It is recommended that certain alignment procedures be performed periodically to ensure continued reliable performance of the unit. Other alignment procedures are performed at the factory and should not need to be repeated. In the interest of completeness, all significant adjustments are included. The alignments that should be checked periodically are those covered in paragraphs 4.3.2 through 4.3.7.

4.2 RECOMMENDED TEST EQUIPMENT

Table 4-1 is a list of recommended test equipment to be used when performing the alignment procedures. Equivalent test equipment may be substituted for any of the items listed.

Table 4-1. Recommended Test Equipment

ITEM	MFG. AND MODEL NO.
Microwave Frequency Counter (to 18 GHz; Calibrated)	Hewlett-Packard Model HP5340A
Digital Multimeter	Fluke Model 8600
Thruline Wattmeter	Bird Model 43 with plug-in 5B
Spectrum Analyzer Mainframe	Hewlett-Packard Model 8552B/141T
Spectrum Analyzer	Hewlett-Packard Model 8555A with RF Plug-in
Mixer (12.4 to 40 GHz)	Hewlett-Packard Model 11517A
Frequency Programming Unit	Watkins-Johnson Model 1258[1]
Oscilloscope	Tektronix Model 475
Miscellaneous:	Non-Metalic screw driver

[1]Optional. Allows the WJ-1250A to be programmed at a fast rate such that various parameters of the system can be observed. This rate is equivalent to remotely programming the system by a computer.

4.3 ALIGNMENT PROCEDURES

The following paragraphs cover all adjustments required for the WJ-1250A Frequency Synthesizer. Allow at least one-half hour warm up time prior to starting alignment. Each procedure is first discussed and then presented in step-by-step form. Adjustments should be checked at 60 to 90 day intervals to ensure continued reliable operation of the unit. Figure 4-1 is provided for ease in parts and assembly identification during alignment, troubleshooting, or testing.

To gain access to the unit, remove the WJ-1250A from the instrument case (if applicable). Removing the four front panel screws and the top dust cover assembly by removing screws on each side. Remove the respective WJ-1251-xx RF Source from the WJ-1250A mainframe and/or WJ-1253C Multisource Chassis. Remove the top dust cover. Re-install the RF source(s) into the appropriate WJ-1250A or WJ-1253C.

CAUTION

Units must be turned OFF prior to removing or installing RF Source(s).

At completion of alignment procedures, replace all dust covers, re-install unit in instrument case (if applicable) and replace four front panel screws.

4.3.1 POWER SUPPLY PS1, ALIGNMENT

The alignment of Power Supply PS1, is factory set and should not need to be repeated. However, in the interest of completeness, the alignment is provided in the following paragraph.

4.3.1.1 Alignment. Perform the following steps to align Power Supply PS1.

a. Remove top dust cover from unit.

b. Attach DVM red test lead to appropriate power supply terminal pin (as indicated in Table 4-2) and black test lead to pin 7 (GND).

c. Observe DVM and set appropriate adjustment screw (located on top of PS1) to adjustment setting listed in Table 4-2.

d. Remove DVM test leads.

e. Replace top dust cover.

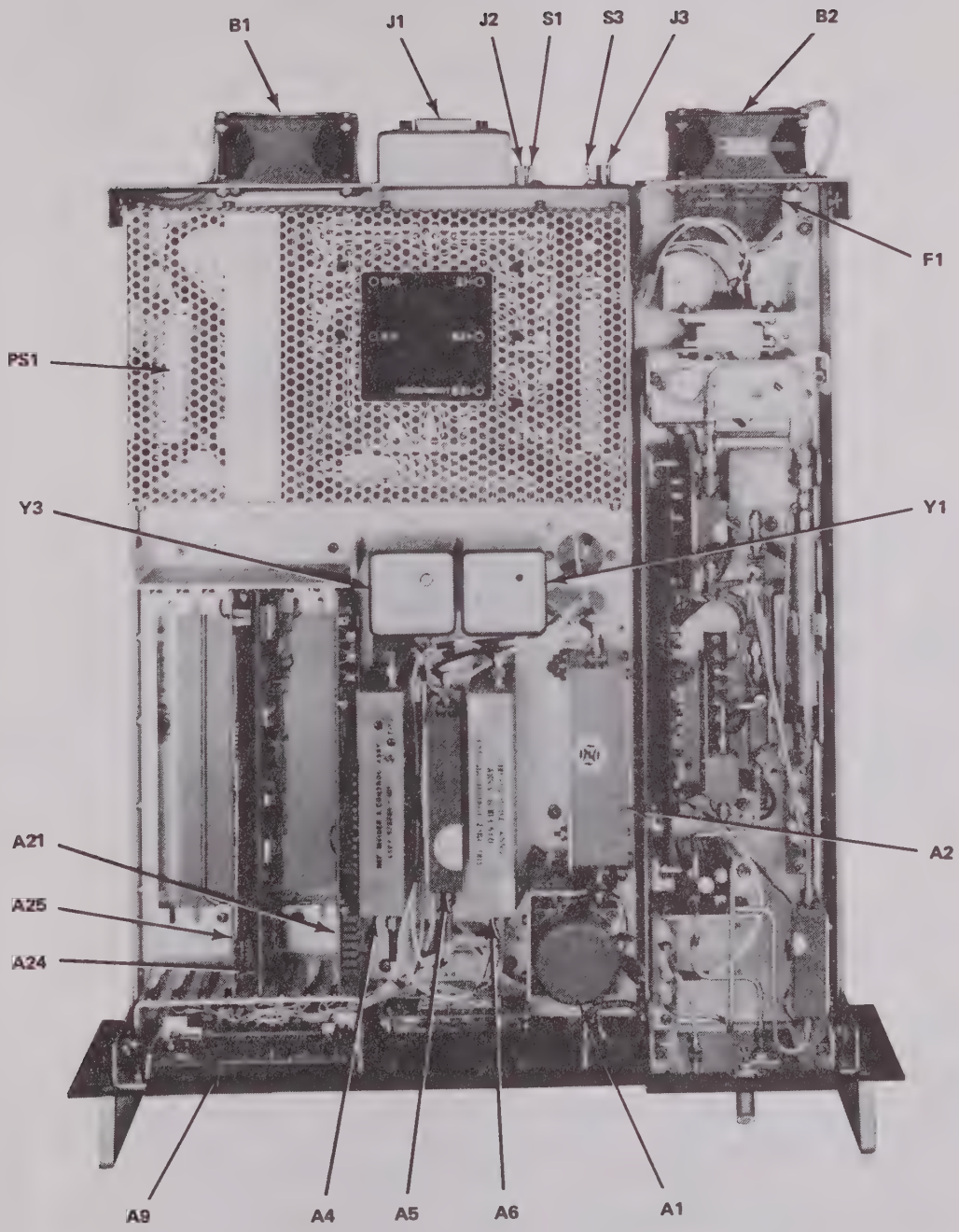


Figure 4-1. WJ-1250A Frequency Synthesizer, Top View and Cover Removed.

Table 4-2. Power Supply Adjustment Settings

TB2	ADJUSTMENT SETTING	WIRE COLOR
3	+ 28 (unswitched ± 0.2	Violet
4	+ 28 ± 0.1	Red
5	+ 15 ± 0.1	White/Red
6	+ 5 ± 0.1	Yellow
7	GND	
8	- 15 ± 0.1	White/Violet
9	- 22 (unregulated)	Green

NOTE

The +28 V (unswitched) supply is on as long as the unit is plugged into an outlet. There is no adjustment for the -22 V (unregulated) supply; green wire-terminal 9.

4.3.2 5 MHz XTAL OSCIALLATOR Y1, ALIGNMENT

Since frequency accuracy is determined by the 5 MHz XTAL oscillator, it is desirable to use calibration laboratory techniques to adjust the 5 MHz output signal directly; i.e., phase comparison against a primary 5 MHz standard. When this is achieved, bear in mind that the 5 MHz reference at the rear panel connector (J2) is a TTL signal.

CAUTION

Do not load with an impedance that is less than 1 k Ohms.

In lieu of directly calibrating the output of the 5 MHz oscillator, it may be more convenient to perform the calibration by measuring the microwave output of the Synthesizer. For example: An accuracy of ± 1 part in 10^9 is ± 1 Hz at 1 GHz. Such an accuracy may be read directly by using a microwave frequency counter having a sufficiently accurate and recently calibrated secondary standard as its time base reference. Whichever method is used, the actual adjustment of the 5 MHz oscillator is accomplished as follows:

4.3.2.1 Alignment. Perform the following steps to align 5 MHz XTAL Oscillator Y1.

a. Verify that the INT/EXT Switch (real panel) is set to INT.

b. If a direct calibration at 5 MHz is to be made, connect calibrating equipment to EXT RF connector.

c. If a calibration at microwave frequencies is to be made, program the unit to a suitable frequency and connect the microwave output to a calibrated frequency counter.

d. Remove top dust cover. Remove cap screw on Y1.

e. Use a non-metallic alignment tool to adjust the frequency of Y1 until it is within tolerance as determined by the calibration equipment.

f. Replace cap screw on Y1. Replace top dust cover.

NOTE

If the 100 MHz Oscillator (Y3) is not locked to the 5 MHz Oscillator (Y1) no change in output frequency will be observed as the tuning slug in Y1 is adjusted. (See paragraph 4.3.3 to lock Y3 to Y1).

4.3.3 100 MHz VCXO Y3, ALIGNMENT

100 MHz VCXO Y3, is phase-locked to the internal or external 5 MHz reference signal. The purpose of this adjustment is to ensure that Y3 achieves lock approximately in the center of its voltage-controlled range. Hence, the lock loop will have maximum control range over Y3 should it attempt to drift in either direction from its locked frequency. As the Y3 is oven-controlled, this adjustment should be performed after oven temperature has stabilized. Since oven power is ON when AC is applied to the unit, it is only necessary to plug it in 30 to 45 minutes prior to alignment.

4.3.3.1 Alignment. Perform the following steps to align 100 MHz VCXO Y3.

a. Ensure at least one-half hour warm up time prior to starting alignment.

b. Remove cover from unit. Remove cap screw from Y3.

c. Use a digital voltmeter or calibrated oscilloscope to monitor voltage at A4TP1.

NOTE

This point monitors the control voltage that phase-locks Y3. The voltage has a dynamic range of approximately - 0.6 to + 14 Volts; however, the useful control range for phase-locking Y3 is from 1 Volt to approximately + 10 Volts. The voltage/frequency characteristic of the VCXO is non-linear. The approximate mid-point of its frequency control range occurs at a control voltage of + 4 Volts.

d. Use a non-metallic alignment tool to adjust frequency control of Y3 until voltage at A4TP1 reads nominally + 4 Volts.

e. Replace cap screw on Y3, remove probe from A4 TP1, and replace cover on the Synthesizer.

4.3.4 YTO D/A COARSE-TUNE DRIVER, ALIGNMENT

Alignment of the YTO D/A Converter on A25 is performed with the use of a WJ-1251-xx RF Source. The YTO D/A converter provides an analog output voltage which is used to coarse tune YIG Tuned Oscillator Y1, in the WJ-1251-xx RF Source. The output of the D/A converter starts at zero Volts, at the low frequency of each RF Source, and ramps upward with a slope of 1 V/GHz to the highest frequency of the source.

NOTE

This procedure does not apply to all RF Sources. Therefore, the technical manual for the specific RF Source being used should be consulted for any departure from this procedure.

4.3.4.1 Alignment. Perform the following steps for the YTO D/A Coarse Tune alignment.

a. Remove covers from Synthesizer and RF Source.

b. Attach positive voltage probe of a digital voltmeter to TP1 of A25 and attach negative probe to the negative side (indicated by black wire) of R1 in the WJ-1251-xx RF Source Assembly.

c. Program the WJ-1250A to the lower frequency limit of the WJ-1251-xx RF Source.

d. Adjust R2 to 0.000 Volts $\pm$ .001.

e. Program to the upper frequency limit of the RF Source.

f. Adjust R1 to Upper Limit (GHz) - Lower Limit (GHz) times 1 Volt/GHz.

Example: WJ-1251-4 4-8 GHz RF source
Upper Limit = 8 GHz Lower Limit = 4 GHz
(8-4) GHz x 1 volt/GHz = 4 Volts.

NOTE

This Upper Limit and Lower Limit refers to individual RF Sources, not total system frequency coverage.

g. Repeat Steps c through f as necessary to obtain proper voltages at both endpoints.

h. Replace Synthesizer and RF Source covers.

4.3.5 HARMONIC GENERATOR DRIVER A21, ALIGNMENT

The alignment of Harmonic Generator Driver A21 is the most critical of all the Synthesizer adjustments. The driver must be properly aligned so that the YIG filter in Harmonic Multiplier Assembly A1 is centered on the proper 100 MHz harmonic. Since the filter bandwidth is relatively narrow (≅10 MHz) and the roll-off of the YIG filter is relatively sharp, a slight frequency mistuning can cause the level of the reference harmonic to fall below that required (approximately - 40 dBm) for proper operation of the unit.

A series of potentiometers on the Harmonic Generator Driver control the alignment of YIG Tuned Harmonic Multiplier Assembly A1. The total tuning range of A21 is arbitrarily divided into seven segments in order to provide greater accuracy in the adjustments that follow. For each of the seven segments, there are three potentiometers which control the tuning parameters of that particular band segment. No segment interacts with any other segment. There is also one additional potentiometer which controls the reference voltage applied to the Harmonic Generator Driver D to A converter. Typical band ranges and potentiometer assignments for each segment are described in Table 3-3. Actual band segments are determined at the factory prior to delivery to ensure linear tuning of YIG Tuned Harmonic Multiplier A1.

All of the potentiometers are adjusted at the factory. Generally speaking, for periodic realignment of the driver circuitry, only starting current potentiometers R2A through R2G need be adjusted. However, the complete procedure involving all adjustments is provided in the paragraphs that follow.

Adjustments required for alignment of YIG Tuned Harmonic Multiplier Assembly A1, are performed on Harmonic Generator Driver A21. First remove the Synthesizer cover to gain access to the contained electronics.

The alignment of any one of the seven band segments follows the same general procedure. First, R16 is adjusted to obtain the proper reference voltage for the Harmonic Generator D to A Converter U10. This adjustment is only made once and is not repeated for each of the seven band segments. The Synthesizer is then programmed to the lowest frequency in one of the band segments (e.g., 3.95 GHz for segment D).

Potentiometer R2D is then adjusted to obtain the proper tuning current through the coil for this reference harmonic. Next, program the Synthesizer to the highest frequency in the band segment (e.g., 7.94 GHz for segment D). Now adjust R1D to obtain the proper tuning current at this frequency.

NOTE

Within each of the seven band segments, the adjustment of potentiometers R1 and R2 will be interacting. It will thus be necessary to repeat the procedure at both the high and low frequencies of each segment until the proper tuning current flows through the coil at both extremes.

Once the proper tuning current curve is obtained, potentiometer R3 is adjusted to provide the proper bias voltage for each segment. The R3 adjustment interacts slightly with the adjustments to provide the tuning current.

Each of the seven segments are aligned in a similar manner to that described above. The order in which the segments are aligned is of no consequence, but the order of adjustments within each segment is critical.

4.3.6 HARMONIC GENERATOR DRIVER, A21, ALIGNMENT FROM TUNING DATA

Normally, the Harmonic Generator Driver is aligned at the factory and needs no further adjustments. In some instances, it may be necessary to realign the Harmonic Generator Driver to those values initially established at the factory for proper operation of the unit. The only equipment needed to perform the alignment is a 3-1/2 digit DVM and a copy of the alignment data provided with the Synthesizer.

First remove the Synthesizer cover to gain access to Harmonic Generator Driver A21. Locate an RF Source covering the frequency range of the band segment to be aligned. It may be necessary to use more than one RF Source in performing this alignment because the Synthesizer must actually be programmed to both end point frequencies of the band segment.

Install an RF Source whose range includes the low band edge frequency of the band segment to be aligned. Press the Synthesizer POWER ON switch to turn the unit on. Connect the Ground Probe of a DVM to TP2 on the Harmonic Generator Driver Assembly. Program the Synthesizer to the low band edge frequency of the segment being aligned (e.g., 7.95 GHz for segment E). Connect the remaining DVM probe to test point 4 (TP4) on the Harmonic Generator Driver Assembly. Adjust R16 until the DVM reads 10.000 Volts. Remove the probe from TP4 and reconnect it to TP1. The two DVM probes are now connected across the sense resistor for the Harmonic Generator tuning current. By measuring the voltage appearing across this resistor, it is easy to calculate the current flowing through the tuning coil of YIG Tuned Harmonic Multiplier Assembly A1.

CAUTION

It may be necessary to change RF Sources in switching between the lower and upper band edge frequencies. If this change is required, turn the Synthesizer OFF before removing the RF Source and install the new RF Source before turning the Synthesizer back ON.

Repeat the adjustments of R2E and R1E as many times is necessary until both readings agree with the supplied tuning data. The harmonic generator is now aligned over segment E of its tuning range. The procedure described above is repeated for any of the other six segments, substituting the appropriate potentiometers for that segment.

If RF Sources are not available to cover an entire band segment, a partial alignment can be performed over the range of the segment that the installed RF Source will allow. It is only necessary to adjust R2 at the lowest frequency obtainable, and to adjust R1 at the highest frequency obtainable within both the RF Source and the band segment undergoing alignment. As stated before, an iterative procedure may be necessary to obtain the correct tuning current across the entire band segment.

The adjustment of Bias Potentiometers, R3A through R3G, cannot be made from the tuning data alone. The complete alignment procedures are described in the following paragraphs.

This completes the alignment using tuning data. Although this is not the best method for obtaining the proper tuning characteristics, it is definitely the fastest and requires the least amount of test equipment. Remove the DVM probes from Harmonic Generator Driver A21, and replace the top cover on the Synthesizer mainframe.

4.3.7 HARMONIC GENERATOR DRIVER, A21, ALIGNMENT USING INSTRUMENTS

The procedure described in Paragraph 4.3.6 will be adequate for realignment of YIG Tuned Harmonic Multiplier Assembly A1, in most cases. However, aging of components may make the factory supplied tuning data inadequate for obtaining a properly aligned unit. In other cases, the tuning data may not be available and so another means of aligning the harmonic generator assembly is provided.

First, remove the top cover from the Synthesizer mainframe to gain access to Harmonic Generator Driver A21. Connect the spectrum analyzer input to the REF OUT jack on the front panel of the Synthesizer mainframe. Connect the Ground Probe of the DVM to TP2 on Harmonic Generator Driver A21. Connect the remaining DVM probe to TP4 on the same assembly.

In order to simplify the following procedure, the alignment of band segment E (7.95-9.99 GHz) will be described. All other band segments may be aligned in a similar manner using the adjustment potentiometers appropriate to that segment (refer to Table 3-3).

Install an RF Source whose frequency range includes 7.95 GHz (lowest frequency in segment E). Do Not install RF jumper assembly W2, from the REF OUT jack on the Synthesizer mainframe to the REF IN jack on the RF source. Depress the Synthesizer POWER ON switch to turn the unit on.

While monitoring the voltage at TP4, adjust R16 until the DVM indicates 10.000 Volts. Disconnect the DVM probe from TP4 and reconnect the probe to TP1. Program the Synthesizer to 7.95 GHz (lowest frequency in segment E). Tune the spectrum analyzer to 7.90 GHz. (Refer to note at end of paragraph 4.3.7.1.) Adjust R2E until the amplitude of the signal displayed on the analyzer is at its maximum. Record the tuning voltage at TP1 as displayed on the DVM. Program the Synthesizer to 9.99 GHz.

NOTE

It may be necessary to switch RF Sources in order to perform this step. Always turn the Synthesizer OFF when removing or installing RF Sources.

With the Synthesizer programmed to 9.99 GHz, tune the spectrum analyzer to 9.90 GHz. (Refer to note at end of paragraph 4.3.7.1) Adjust R1E until the displayed harmonic is at maximun amplitude. Record the tuning voltage at TP1 as displayed on the DVM.

Potentiometers R1E and R2E interact. It will therefore be necessary to repeat the adjustments at 7.95 GHz (R2E) and at 9.99 GHz (R1E) until the DVM readings at both end points agree with the recorded values. Remember that these recorded values correspond to

the tuning current that gives the maximum amplitude of the reference harmonic at each particular frequency.

Bias potentiometer R3E is now adjusted while observing the reference harmonic on the spectrum analyzer. As R3E is varied over its entire range, observe that the spectrum of the harmonic breaks up at a few points and finally the power output decreases as the bias voltage is increased too far. The proper setting of R3E is at the point where the power content of the harmonic begins to vary. Adjust R3E clockwise until the power output of the reference harmonic begins to decrease. Then, adjust R3E counterclockwise for 1/4 turn making sure that the reference harmonic does not break up. If it does break up, continue turning R3E counterclockwise until the harmonic stabilizes.

At this point, it is recommended that the band segment be stepped through in 100 MHz increments while observing the amplitude of each successive harmonic on the spectrum analyzer. This is to determine if any particularly low-power harmonic exists in this band segment. If a harmonic (or possibly a few) is found with particularly low power, then R2E may be slightly readjusted in an attempt to peak the power at these frequencies. Of course this will result in the loss of power at other frequencies, but the entire purpose of the alignment procedure is to obtain the maximum power output of the harmonic generator assembly over the entire band segment.

If any of the reference harmonics are broken up, it will be necessary to slightly readjust R3E until all harmonics are stabilized and have relatively high power content.

The procedure described above was specifically for the alignment of band segment E. Alignment of any or all of the other band segments follows an identical procedure except that the appropriate frequencies and adjustment potentiometers are substituted for R1E, R2E, and R3E as described in Table 3-3. This completes the alignment of Harmonic Generator Driver A21.

4.3.7.1 Alignment. Perform the following steps to align Harmonic Generator Driver A21.

a. Remove top dust cover of Synthesizer mainframe.

b. Connect spectrum analyzer to REF OUT jack on front panel.

c. Connect DVM to TP2 and TP4 on Harmonic Generator Driver A21 (TP2 is ground).

d. Install appropriate RF Source. Turn Synthesizer ON.

e. Adjust R16 until DVM indicates 10.000 Volts.

f. Disconnect DVM probe from TP4 and reconnect it to TP1.

g. Program Synthesizer to lowest frequency in a particular band segment (e.g., 3.95 GHz for segment D).

h. Adjust R2D until amplitude of REF harmonic is at its maximum.

i. Program Synthesizer to highest frequency in band segment.

j. Adjust R1D until amplitude of REF harmonic is at its maximium.

k. Repeat Steps g through k above until REF harmonic is maximum at both ends of the band segment.

l. Adjust R3D at highest frequency in band segment by turning CW until power level just begins to decrease.

m. Repeat Steps g through k above and record voltages at both end points.

n. Program frequencies throughout the band segment and make sure that no harmonic has extremely low power. If such a condition exists, slightly adjust R2D until power increases. Then program through the band again.

o. This completes the alignment of one of the seven band segments. To align any or all other segments, repeat Steps d through g above omitting e and f.

CAUTION

Turn Synthesizer OFF when installing or removing RF Sources.

p. Replace top dust cover of Synthesizer.

NOTE

Some WJ-1250A Synthesizers have IF frequencies ranging from 50.0 - 149.9 MHz while other units have IF frequencies ranging from 300.0 - 399.9 MHz. Before aligning the harmonic generator, it is essential to know which is the proper harmonic.

The harmonic is chosen in such a manner that when the harmonic frequency is subtracted from the actual programmed frequency, the resulting IF is within the actual IF band of the Synthesizer.

4.4 TROUBLESHOOTING PROCEDURES

Table 4-3 is a troubleshooting table which explains the symptom, probable cause(s), and corrective action procedures essential in resolving most failures likely to occur in the WJ-1250A. Malfunctions are isolated to a defective circuit card or part according to discrepancies observed while using test equipment. These discrepancies are corrected by replacing the defective circuit card or part, or returning the entire unit to the factory for servicing. Detailed troubleshooting of the defective circuit card is beyond the scope of this manual.

Table 4-3. WJ-1250A Frequency Synthesizer Fault Isolation

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
1. Front panel indicators do not illuminate and blowers are not running.	a. No AC power.	a. Check AC plug. b. Check Input filter Module. c. Check POWER ON switch.
2. Front panel not illuminated, but blowers are running.	a. Faulty power supply (+28V). b. Broken switch wire to power supply.	a. Check PS1. Refer to paragraph 4.3.1. Replace if defective. b. Repair wire.
3. Some front panel lamps not illuminated.	a. Bulbs burnt out.	a. Replace bulbs.
4. LED Display not illuminated.	a. Faulty power supply (+5V). b. Display board not installed in connector.	a. Check PS1. Refer to paragraph 4.3.1. Replace if defective. b. Install LED Display.
5. ON/OFF switch flashing.	a. Faulty power supply. b. Shorted power supply output.	a. Check PS1. Refer to paragraph 4.3.1. Replace if defective. b. Locate cause of short and repair.
6. LOCAL/REMOTE switch does not switch to REMOTE.	a. Defective LOCAL/REMOTE switch. b. Z-80 Controller A24 is defective.	a. Replace switch, S4. b. Replace A24.
7. Unit fails to achieve locked status at any frequency.	a. LOCKED/UNLOCK switch DS1 in wrong position. b. Front panel jumper missing or defective. c. Circuit card not properly inserted in socket.	a. Set switch to Lock. b. Replace jumper. c. Insert circuit card.

Table 4-3. WJ-1250A Frequency Synthesizer Fault Isolation (Continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
7. (Continued)	d. 100 MHz OSC Y3 defective.	d. Replace Y3.
	e. Improper alignment of Harmonic Generator Driver A21.	e. Refer to alignment procedures in paragraph 4.3.5.
	f. Faulty power supply.	f. Check PS1. Refer to paragraph 4.3.1. Replace if defective.
	g. Other problems.	g. Consult Factory.
8. Unit fails to achieve locked status in one RF source.	a. Faulty RF source.	a. Refer to appropriate RF source manual.
	b. Improper alignment of Harmonic Generator Driver A21.	b. Refer to alignment procedures in paragraph 4.3.5.
	c. Other problems.	c. Consult factory.
9. Unit fails to achieve lock at certain frequencies but will lock in others.	a. Improper alignment of Harmonic Generator Driver A21.	a. Refer to alignment procedures in paragraph 4.3.5.
	b. Improper alignment of YIG-Tuned Oscillator Y1 in RF Source.	b. Refer to appropriate RF source manual.
	c. Improper alignment of YTO D/A voltage.	c. Check YTO D/A (A25) voltage. Refer to alignment procedures in paragraph 4.3.4.
	d. Other problems.	d. Consult factory.
10. No 5 MHz output at rear panel BNC connector J2.	a. Defective 5 MHz XTAL Y1.	a. Replace Y1.
	b. INT/EXT switch S2 in wrong position.	b. Set switch to INT.

Table 4-3. WJ-1250A Frequency Synthesizer Fault Isolation (Continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
10. (Continued)	c. Defective wiring.	c. Repair wires.
	d. Defective switch.	d. Replace switch S2.
11. Unit locked but output spectrum noisy or with 100 kHz spurious signals.	a. Noise pot misadjusted.	a. Adjust A4 R43 to get rid of 60 cycle noise and reduce spurious signals.
	b. Holdoff circuit not functioning.	b. Consult factory.
12. Unit will not accept keyboard commands.	a. LOCAL/REMOTE switch in REMOTE.	a. Switch to local.
	b. Faulty keyboard.	b. Replace keyboard.
	c. LOCAL/REMOTE switch faulty.	c. Replace LOCAL/REMOTE switch.
13. Unit locked but output not at exact frequency programmed.	a. INT/EXT Switch in wrong position.	a. Switch to INT.
	b. 5 MHz XTAL OSC Y1 failed or drifted.	b. Adjust Y1 or replace Y1.
	c. Reference loop unlocked.	c. Refer to alignment procedure.
14. Unit actually locked but indicator indicates UNLOCKED.	a. Transistor drivers for LOCKED/UNLOCKED lamps failed.	a. Replace transistors in A4 module.
15. Unit does not recognize proper band edge frequencies.	a. Faulty wiring in RF source.	a. Refer to appropriate RF source manual.
16. Keyboard commands not performing proper function.	a. Faulty Z-80 Controller A24 or Z-80 I/O Extender A25.	a. Replace A24, or A25 or consult factory.
	b. 500 MHz Programmable Divider CCA, A6, defective.	b. Replace A6.

Table 4-3. WJ-1250A Frequency Synthesizer Fault Isolation (Continued)

SYMPTOM	PROBABLE CAUSE	CORRECTIVE ACTION
17. Unit does not function in REMOTE.	a. LOCAL/REMOTE switch faulty.	a. Replace switch.
	b. Faulty Z-80 Controller A24 or Z-80 I/O Extender A25.	b. Consult factory or replace A25 or A24.
	c. Remote programmer faulty.	c. Repair.
	d. Programming faulty.	d. Consult factory.

Section 5

DIAGRAMS

5.1 SCOPE OF SECTION

The purpose of this section is to provide necessary logic and wiring diagrams as well as assembly drawings for the WJ-1250A Frequency Synthesizer.

5.2 SYSTEM DIAGRAMS

Table 5-1 is a list of diagrams pertaining to the WJ-1250A Frequency Synthesizer.

Table 5-1. List of Diagrams

FIGURE NUMBER	DESCRIPTION
5-1	WJ-1250A Frequency Synthesizer, Assembly Drawing
5-2	WJ-1250A Frequency Synthesizer, RF Interconnection Diagram
5-3	Reference Divider and Control Assembly A4, Schematic Diagram
5-4	500 MHz Programmable Divider Assembly A6, Schematic Diagram
5-5	Six-Digit LED Display and Control Assembly A9, Schematic Diagram
5-6	Keyboard Assembly A10, Schematic Diagram
5-7	Harmonic Generator Driver Circuit Card Assembly A21, Schematic Diagram
5-8	Z-80 Controller Circuit Card Assembly A24, Schematic Diagram
5-9	Z-80 I/O Extender Circuit Card Assembly A25, Schematic Diagram

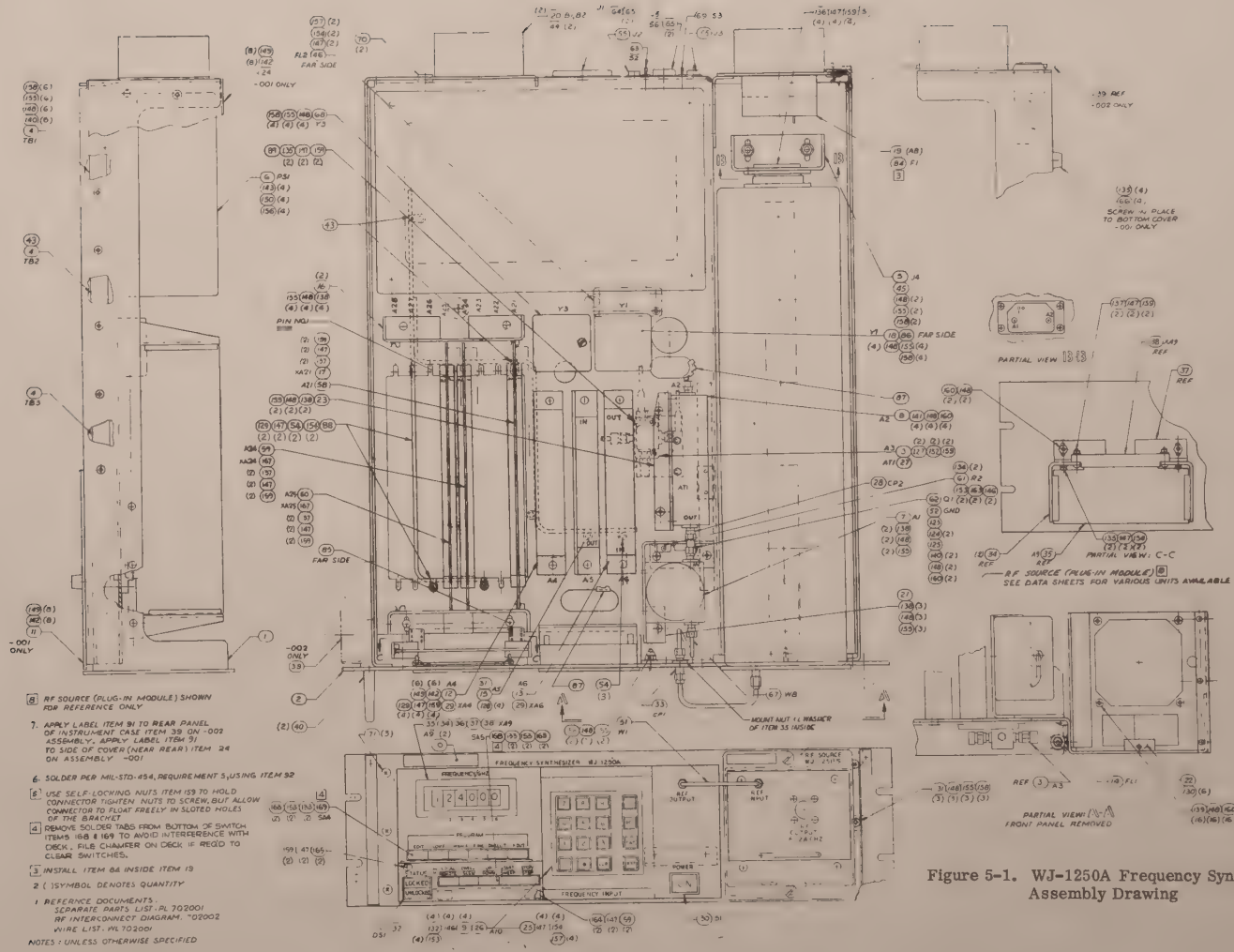
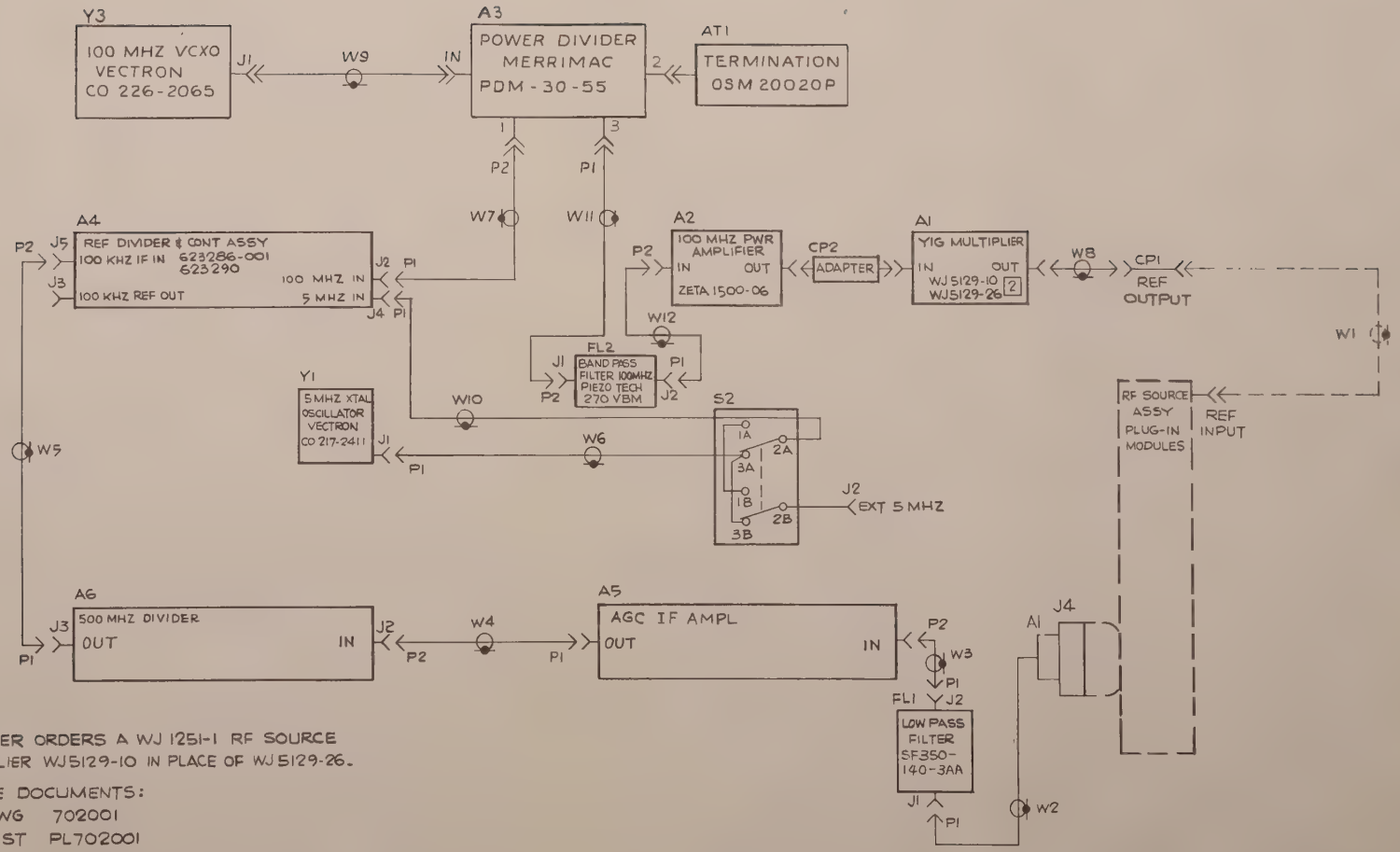

[8] RF SOURCE (PLUG-IN MODULE) SHOWN FOR REFERENCE ONLY
7. APPLY LABEL ITEM 91 TO REAR PANEL OF INSTRUMENT CASE ITEM 39 ON -002 ASSEMBLY; APPLY LABEL ITEM 91 TO SIDE OF COVER (NEAR REAR) ITEM 24 ON ASSEMBLY -001
6. SOLDER PER MIL-STD-454, REQUIREMENT 5, USING ITEM 92
[5] USE SELF-LOCKING NUTS ITEM 159 TO HOLD CONNECTOR TIGHTEN NUTS TO SCREW, BUT ALLOW CONNECTOR TO FLOAT FREELY IN SLOTED HOLES OF THE BRACKET
[4] REMOVE SOLDER TABS FROM BOTTOM OF SWITCH ITEMS 168 & 169 TO AVOID INTERFERENCE WITH DECK. FILE CHAMFER ON DECK IF REQD TO CLEAR SWITCHES.
[3] INSTALL ITEM 84 INSIDE ITEM 13
2 ( ) SYMBOL DENOTES QUANTITY
1 REFERENCE DOCUMENTS: SEPARATE PARTS LIST - PL 702001 RF INTERCONNECT DIAGRAM, "02002 WIRE LIST - WL 702001
NOTES: UNLESS OTHERWISE SPECIFIED
-001 ONLY
-002 ONLY
FAR SIDE
PIN NO.
PARTIAL VIEW: B-B
PARTIAL VIEW: C-C
RF SOURCE (PLUG-IN MODULE) [8]
SEE DATA SHEETS FOR VARIOUS UNITS AVAILABLE
PARTIAL VIEW: A-A
FRONT PANEL REMOVED
SCREW IN PLACE TO BOTTOM COVER -001 ONLY
HOLD NUT 11 WASHER OF ITEM 33 INSIDE
FREQUENCY SYNTHESIZER WJ-1250A
FREQUENCY INPUT
REF OUTPUT
REF INPUT
POWER
LOCKED
UNLOCKED

Figure 5-1. WJ-1250A Frequency Synthesizer, Assembly Drawing



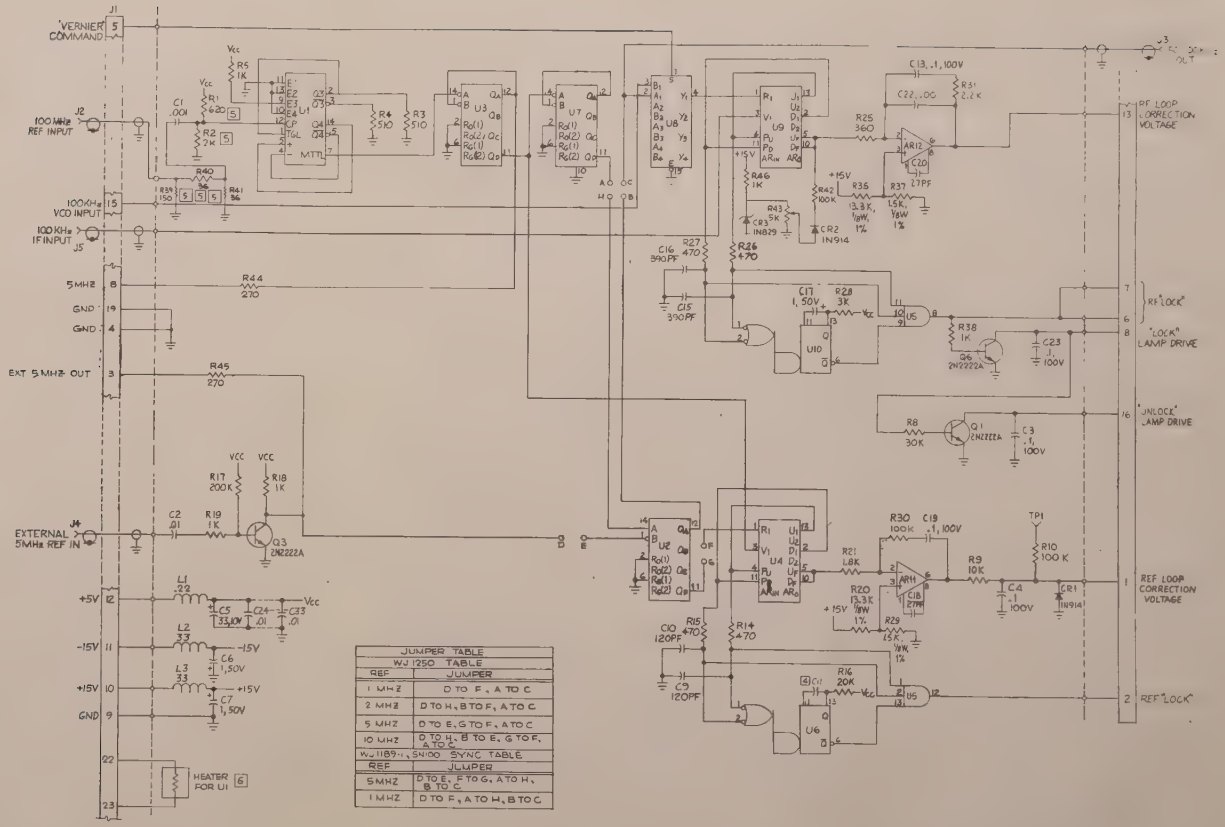
2 IF CUSTOMER ORDERS A WJ 1251-1 RF SOURCE USE MULTIPLIER WJ5129-10 IN PLACE OF WJ 5129-26.

1. REFERENCE DOCUMENTS:
   ASSY DWG 702001
   PARTS LIST PL702001
   WIRE LIST WL702001

NOTES: UNLESS OTHERWISE SPECIFIED

Figure 5-2. WJ-1250A Frequency Synthesizer, RF Interconnect Diagram

702002



JUMPER TABLE	
WJ 1250 TABLE	
REF	JUMPER
1 MHZ	D TO F, A TO C
2 MHZ	D TO H, B TO F, A TO C
5 MHZ	D TO E, G TO F, A TO C
10 MHZ	D TO H, B TO E, G TO F, A TO C
WJ 1189-1, SN100 SYNC TABLE	
REF	JUMPER
5MHZ	D TO E, F TO G, A TO H, B TO C
1 MHZ	D TO F, A TO H, B TO C

INTEGRATED CIRCUIT IDENTIFICATION TABLE							
REF DESIG	TYPE 001	+15V	Vcc	GND	-15V	GKT	TYPE 002
U1	MC12012L	—	6,16	8	—	3	MC12012L
U2,3,7	MC7490L	—	5	10	—	4	SN5490U
U4,9	MC4044L	—	14	7	—	4	MC4044L
U5	7411PC	—	14	7	—	3	SN5411J
U6,10	96C1PC	—	4	7	—	1	7400 OR
U8	SN74157N	—	16	8	—	1	SN5415TU
AR11,12	LM101A	7	—	4	—	1	LM101A

COMPONENT DESIGNATION		
FIRST	LAST	DELETED
C1	C33	C8,C12,C14,C21
CR1	CR3	—
L1	L3	L4,L5
Q1	Q6	Q2,Q4,Q5
R1	R46	R2,R3,R4,R5,R8,R9,R10,R11,R14,R15,R16,R18,R19,R20,R21,R22,R23,R24,R25,R26,R27,R28,R29,R30,R31,R32,R33,R34,R35,R36,R37,R38,R39,R40,R41,R42,R43,R44,R45
TP1	TP1	—

6 USED ON -002 ASSY ONLY.

5 NOMINAL VALUE SHOWN, FINAL VALUE DETERMINED IN TEST.

4 623287-001: C11 IS 1UF, 50V
623287-002: C11 IS .1UF, 100V

3 INDUCTOR VALUES IN MICROHENRYS, 1%

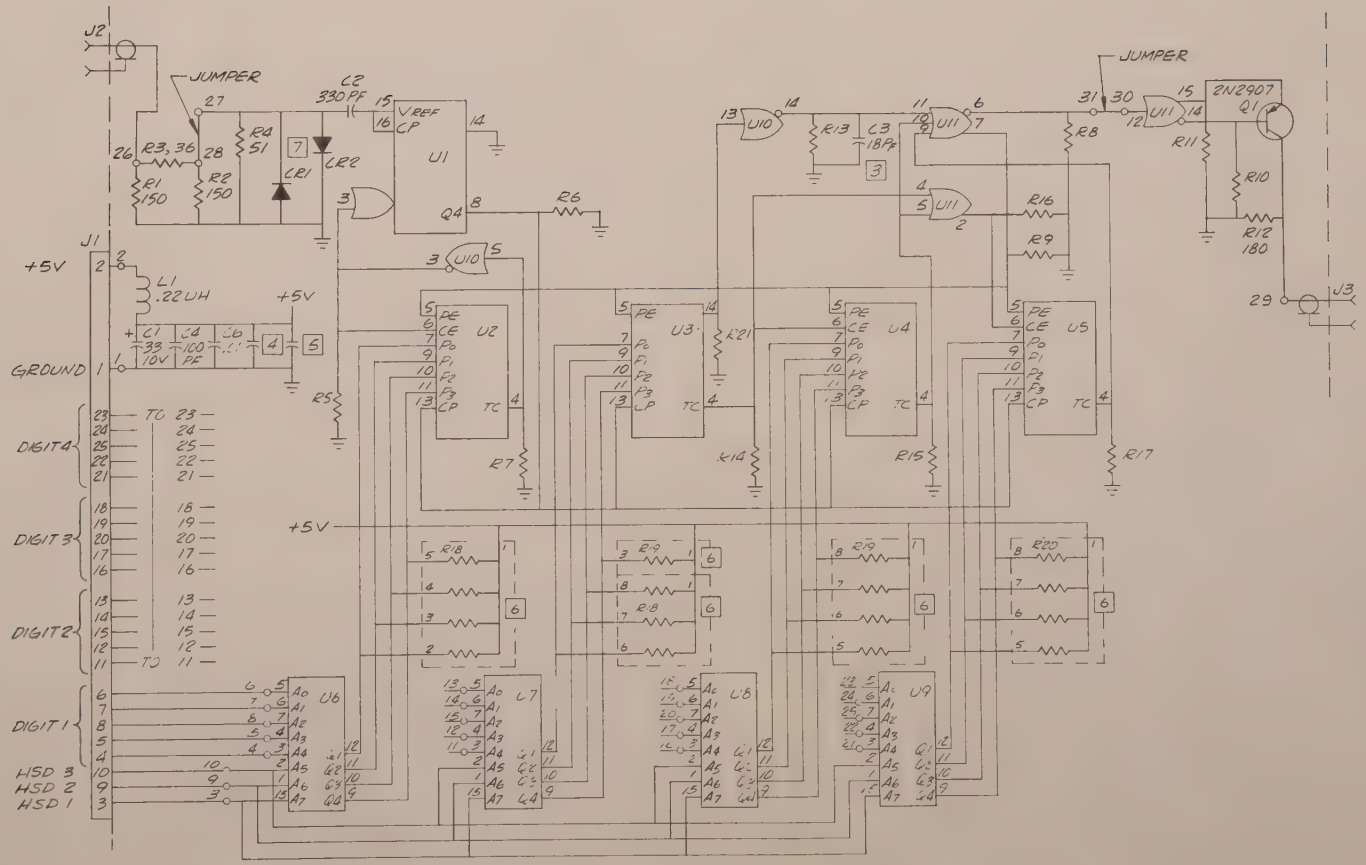
2. CAPACITOR VALUES IN MICROFARADS, 200V, 10%.

1. RESISTOR VALUES IN OHMS, 1/4W, 5%.

NOTES UNLESS OTHERWISE SPECIFIED

623290

Figure 5-3. Reference Divider and Control Assembly A4, Schematic Diagram



COMPONENT REF. DESIG.		
FIRST	LAST	DELETED
C1	C18	-
CR1	CR2	-
L1	L1	-
Q1	Q1	-
R1	R21	-
U1	U11	-

INTEGRATED CIRCUIT IDENTIFICATION TABLE						
REF. DESIG.	TYPE	+5V	VCC	GND	-15V	CKT
U1	1109DC	-	4,5	1/2,8/9	-	1
U2-U5	F9401DC	-	1,16	8	-	1
U6-U9	6300J	-	16	8/3,14	-	1
U10, U11	F9501DC	-	1,16	8	-	1

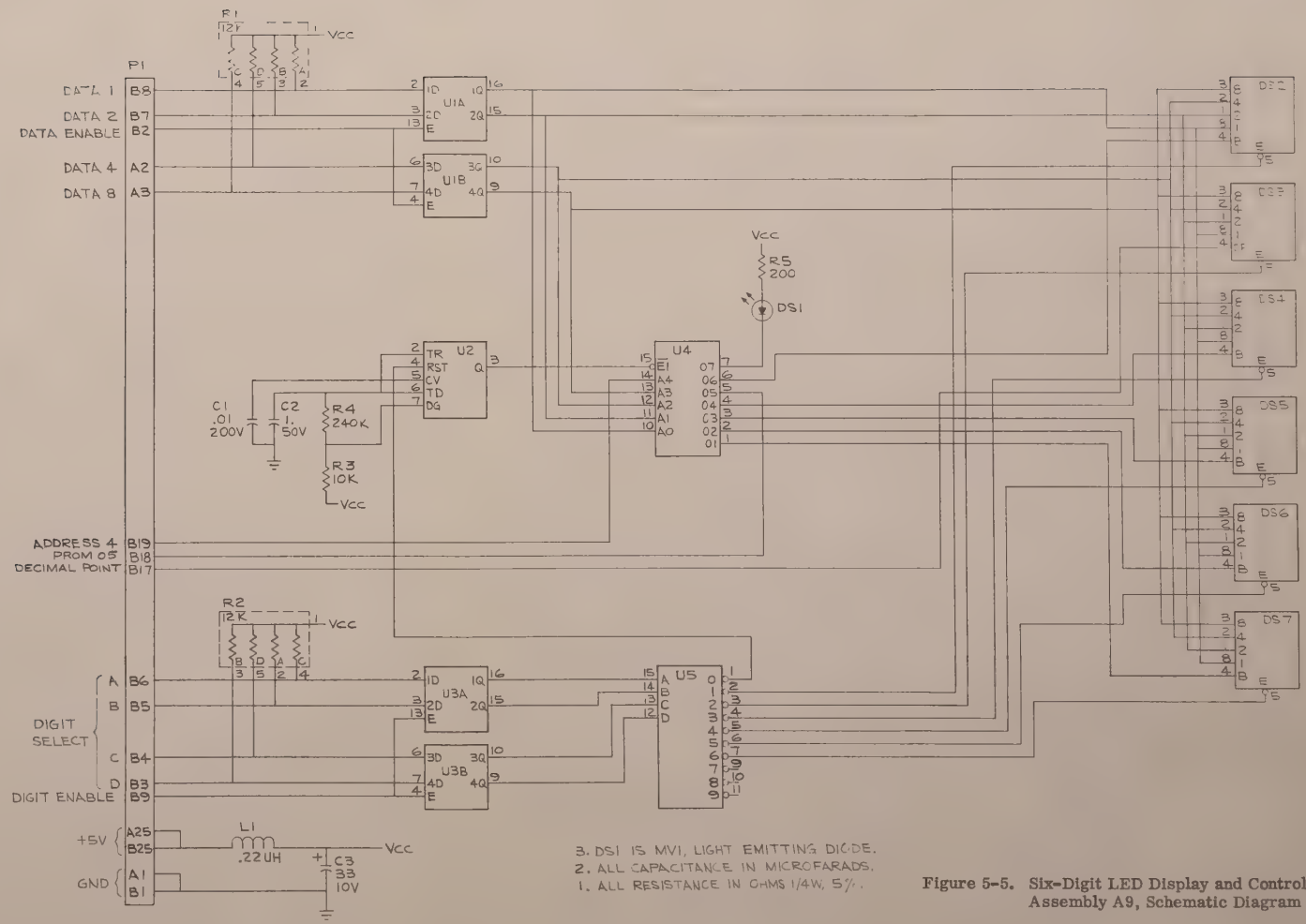
5. C8, C10, C12, C14, C16, C18 ARE 0.1 UF, 50V.
4. C5, C7, C9, C11, C13, C15, C17 ARE 1000 PF.
3. FACTORY SELECT, NOMINAL VALUE SHOWN.
2. ALL RESISTORS ARE 510 OHM, 1/4W, 5%.
1. ALL CAPACITOR VALUES ARE IN UF, 200V, 10%.

NOTES: UNLESS OTHERWISE SPECIFIED

7. DIODES ARE IN914.
6. R18, R19, R20 ARE M. I. L. LE RESISTOR PACKS, 510 OHM.

701683

Figure 5-4. 500 MHz Programmable Divider Assembly A6, Schematic Diagram



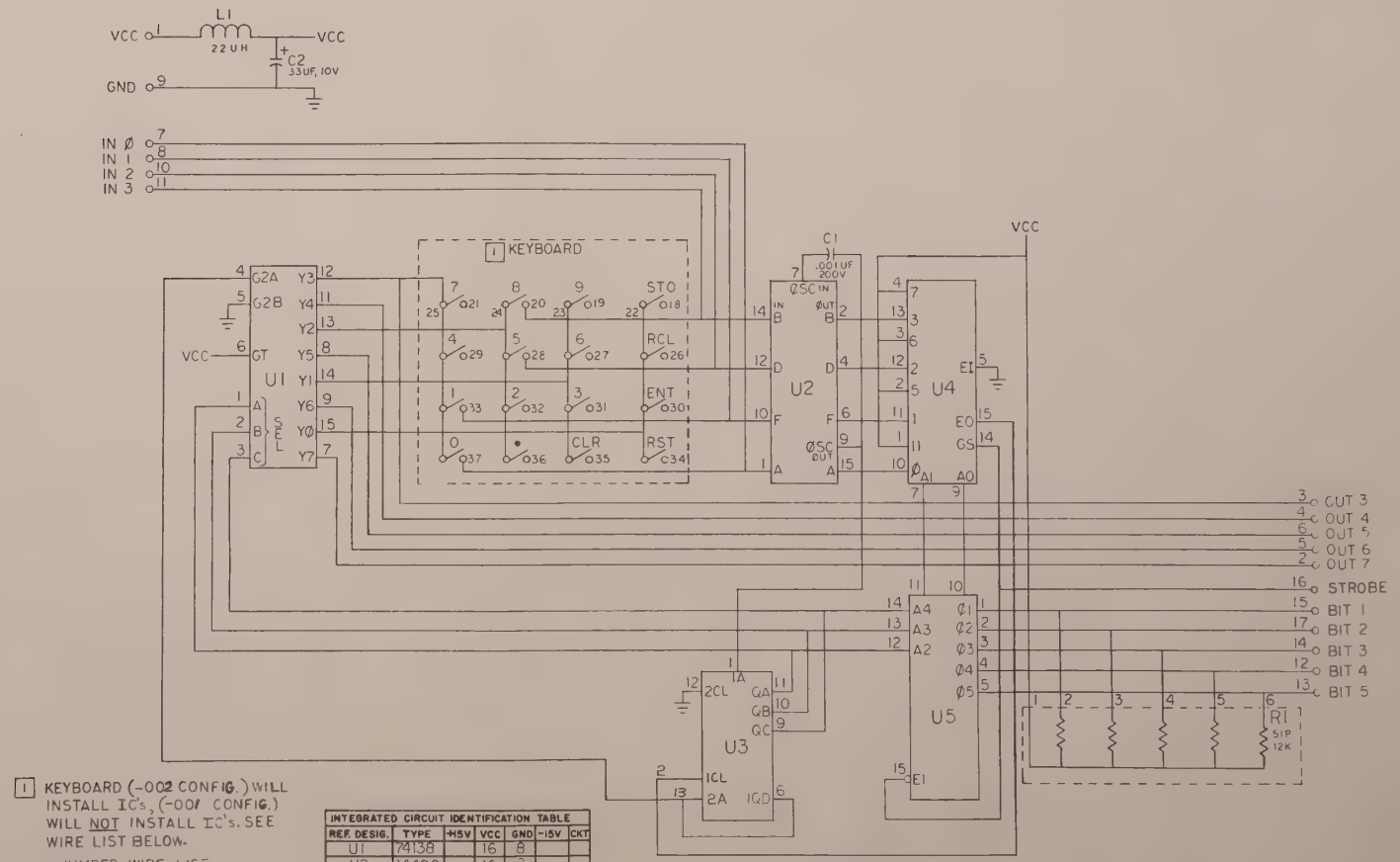
INTEGRATED CIRCUIT IDENT TABLE				
REF DESIG	TYPE	Vcc	GND	CKT
U1, U3	74L75	5	12	2
U2	NE555V	8	1	1
U4	6331-1J	16	8	1
U5	74L42	16	8	1
DS1-DS4-DS7	5082-7340	7	6	1
DS3	5082-7300	7	6	1

COMPONENT REF. DESIG		
FIRST	LAST	DELETED
U1	U5	
DS1	DS7	
R1	R5	
C1	C3	
L1	L1	

3. DS1 IS MV1, LIGHT EMITTING DIODE.
2. ALL CAPACITANCE IN MICROFARADS.
1. ALL RESISTANCE IN OHMS 1/4W, 5%.

Figure 5-5. Six-Digit LED Display and Control Assembly A9, Schematic Diagram

701927



1 KEYBOARD (-002 CONFIG.) WILL INSTALL IC's, (-001 CONFIG.) WILL NOT INSTALL IC's. SEE WIRE LIST BELOW.

JUMPER WIRE LIST

-001	A	22,23,24,25
-002	A	18,19,20,21
	B	26,27,28,29
	C	30,31,32,33
	D	34,35,36,37

INTEGRATED CIRCUIT IDENTIFICATION TABLE

REF. DESIG.	TYPE	+5V	VCC	GND	-15V	CKT
U1	74138		16	8		
U2	14490		16	8		
U3	74393		14	7		
U4	93L18		16	8		
U5	6331		16	8		

COMPONENT REF. DESIG.

FIRST	LAST	DELETED
C1	C2	
R1	—	
L1	—	

Figure 5-6. Keyboard Assembly A10, Schematic Diagram

701946

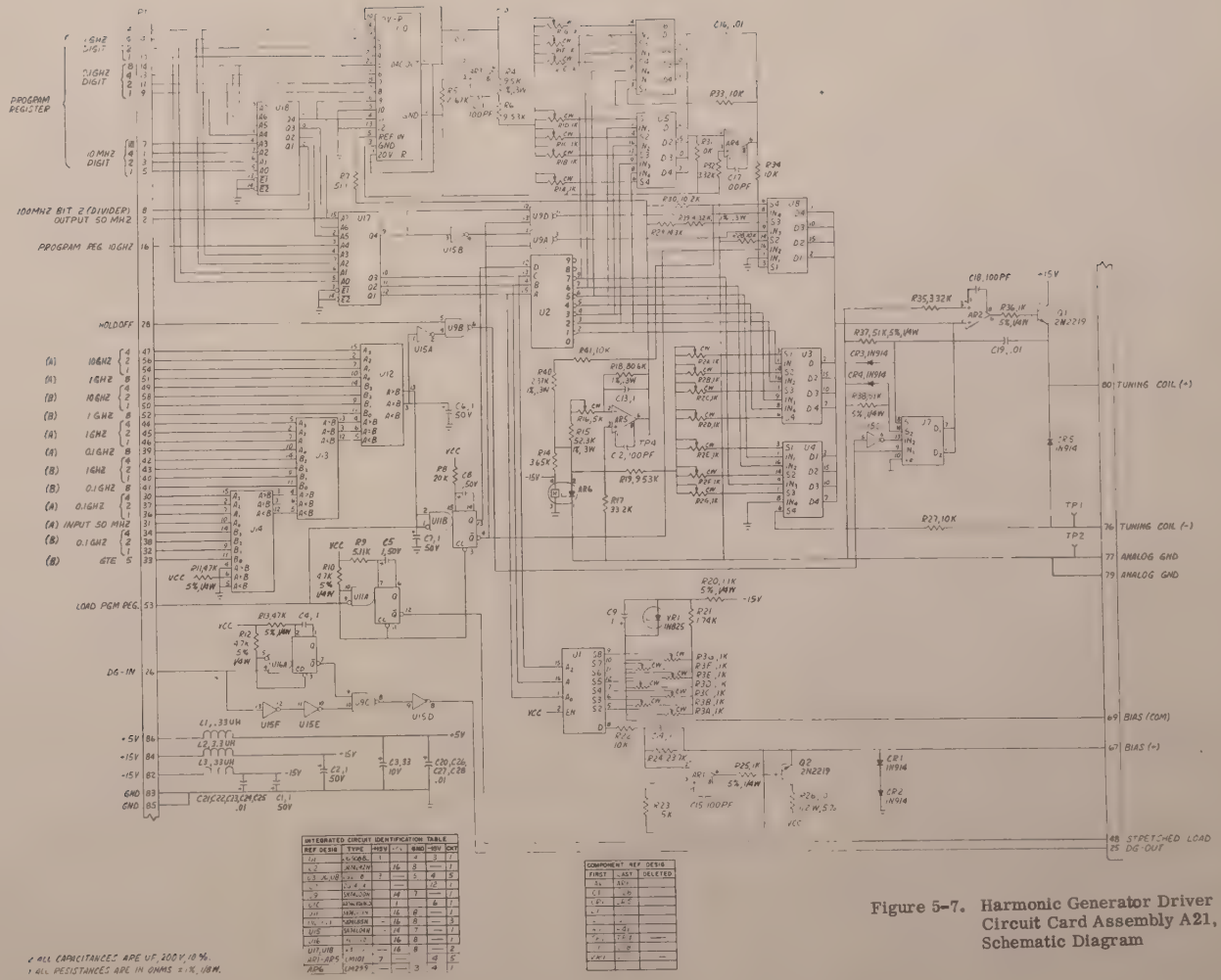


Figure 5-7. Harmonic Generator Driver Circuit Card Assembly A21, Schematic Diagram

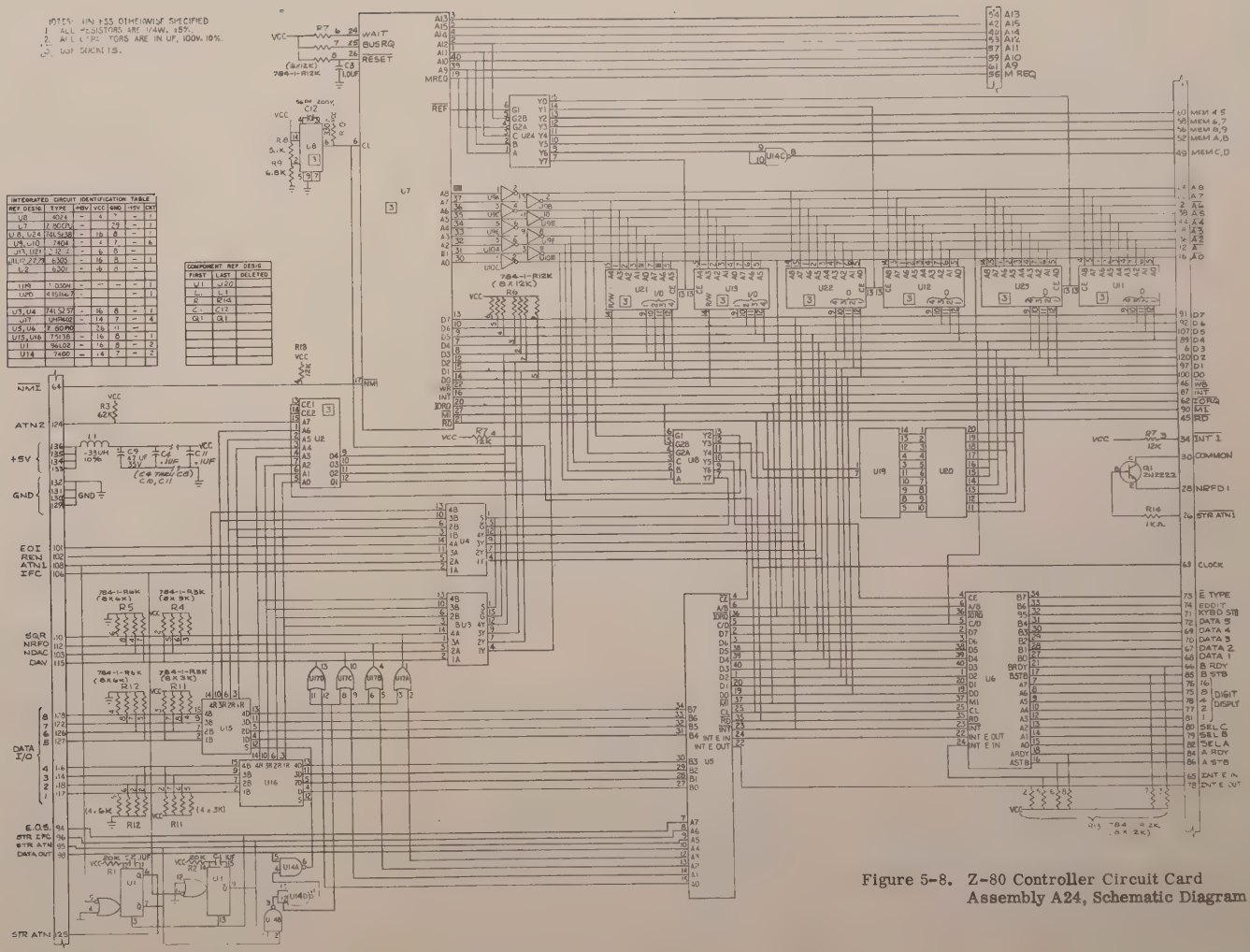
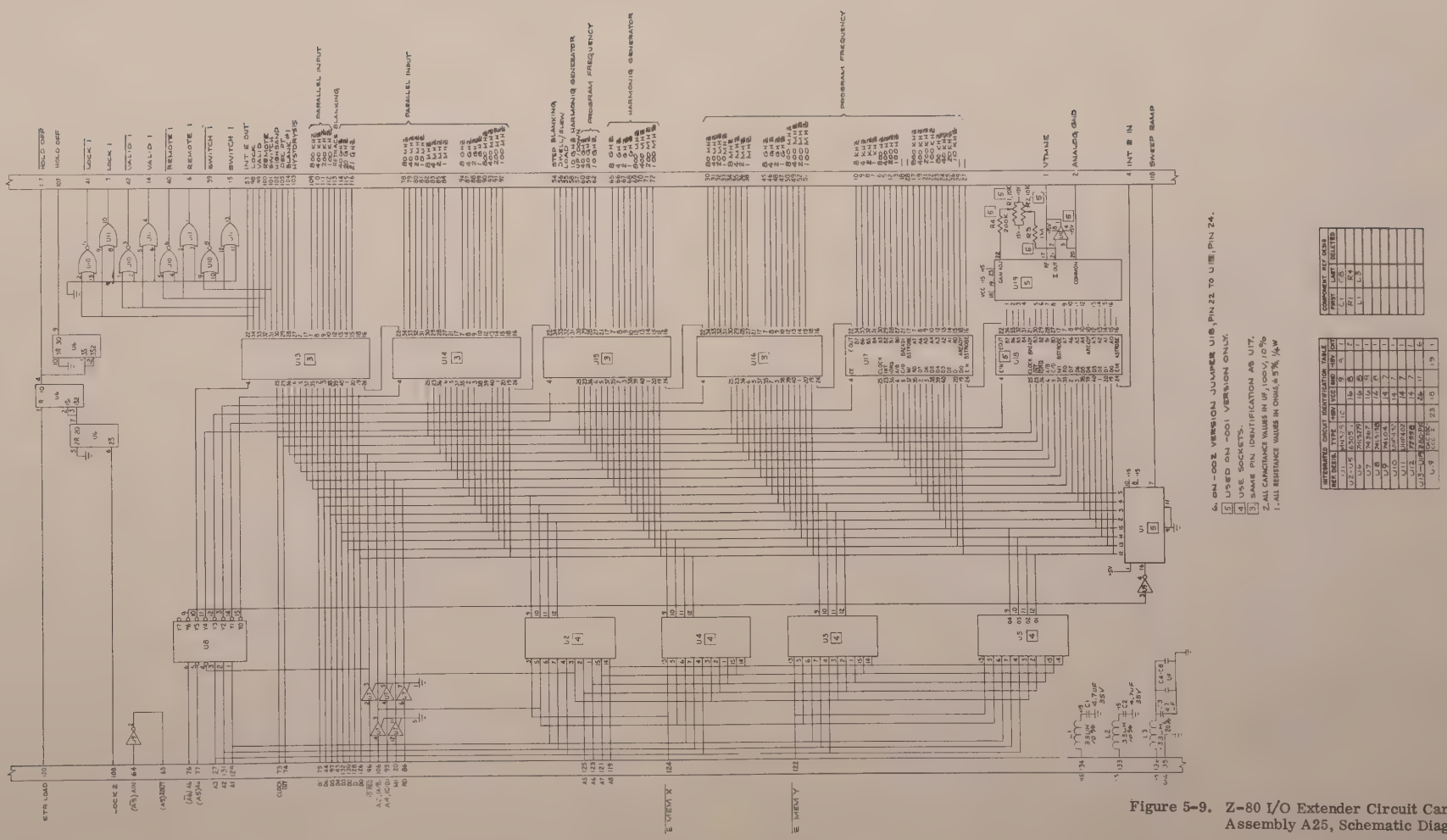


Figure 5-8. Z-80 Controller Circuit Card Assembly A24, Schematic Diagram

701935



6. ON -002 VERSION JUMPER U18, PIN 22 TO U18, PIN 24.
5. USED ON -001 VERSION ONLY.
4. USE SOCKETS.
3. SAME PIN IDENTIFICATION AS U17.
2. ALL CAPACITANCE VALUES IN UF, 100V, ±10%
1. ALL RESISTANCE VALUES IN OHMS, ±5%, ¼W

COMPONENT REF DES	
FIRST	LAST (INCLUSIVE)
C1	C8
R1	R8
L1	L4

INTEGRATED CIRCUIT IDENTIFICATION TABLE					
REF DESIG.	TYPE	+5V(VCC)	GND	+12V	OUT
U1	MM5320	40	20	1	
U2,U3,U4,U5	DM8578	16	8	1	1
U6	DM8578	16	8	1	1
U7	M3827	16	8	1	1
U8	M5150	14	6	1	1
U10	DM8578	16	8	1	1
U11	SN8440	14	7	1	1
U12	77898	14	7	1	1
U13-U16	CA3082	14	11	1	6
U17	CA3161	23	15	1	1,9
U18	CA3162	23	15	1	1
U19	CA3161	23	15	1	1,9

Figure 5-9. Z-80 I/O Extender Circuit Card Assembly A25, Schematic Diagram

701939

Section 6

PARTS LISTS

6.1 SCOPE OF SECTION

This section contains parts lists for the WJ-1250A Frequency Synthesizer. Table 6-1 is a list of manufacturers corresponding to the manufacturers code numbers on the parts lists.

6.2 USE OF PARTS LIST

The individual assembly and subassembly parts lists included in this manual are compiled in an alpha-numeric order, by reference designations; as are the individual parts within each parts list. This arrangement permits the parts lists to be used in conjunction with the applicable schematic diagrams during maintenance. The reference designations for some chassis-mounted parts are identified in Figure 5-1 as well as by markings on the chassis itself; reference designations for board- or module-mounted parts may be determined from markings on each assembly.

The parts lists provide abbreviated descriptions, manufacturer's codes, and part numbers, for the parts. The WJ-1250A Assembly Parts List also contains an assembly drawing part reference number for each major component. When duplicate parts are used, a part is fully identified and described the first time it appears in the list. Subsequent listings refer back to the original entry. The meaning and use of Watkins-Johnson part numbers, the effectivity application code, and the manufacturer's codes are described in the following paragraphs.

6.2.1 WATKINS-JOHNSON PART NUMBERING SYSTEM

Parts designed or manufactured by Watkins-Johnson are identified by nine-digit part numbers. The first six digits of the part number represent the basic part design, and the last three digits, in the form of a dash number, represent the specific configuration of the basic part design.

6.2.2 MANUFACTURER'S CODES

Table 6-1 lists all of the manufacturer's codes used in the WJ-1250A parts lists. These five-digit numbers have been derived from Cataloging Handbook H4-2, Federal Supply Codes for Manufacturers, Code to Name. Codes are not used in the parts lists for standard commercial or military parts.

6.2.3 EFFECTIVITY APPLICATION CODE

The effectivity application code (included on subassembly part lists) is used to indicate that there may be more than one configuration (dash number) of an subassembly being

covered by a single parts list. If a code does not appear in the "APPL TO" column, the listed parts information applies to all configurations covered by the specific parts list.

6.2.4 PART REF NO.

The PART REF NO. (WJ-1250A Assembly Parts List only) is provided for ease in locating the part(s) on the assembly drawing.

6.3 PARTS ORDERING INFORMATION

Replacements for all parts used in the chassis may be obtained from Watkins-Johnson; however, replacements for standard commercial and military parts may be obtained more quickly and easily from local suppliers. When selecting a replacement part, be sure to determine the value, tolerance, rating, and description of the part from the applicable parts list. In cases where circuit performance depends on a factory-selected value, ascertain the value of the replacement part from the marked value of the original part or contact Watkins-Johnson for assistance.

When ordering replacement parts directly from Watkins-Johnson, as in the case of proprietary parts, be sure to specify all information included in the parts list. Also include information that identifies the specific system in which the part is used, as well as the name, part number, and serial number (if indicated) of the next-higher assembly for the part. Be sure to identify any modifications to the system that have been made since the system was shipped from the factory.

Replacement parts may be ordered by mail, telephone, teletype, TELEX, or cablegram. Send orders to the following address:

Mail:	Watkins-Johnson Co., 3333 Hillview Ave., Palo Alto, Ca. 94304
Telephone:	(415) 493-4141
TWX:	910-373-1253
TELEX:	34-8415
Cable:	WJPLA

Table 6-1. Manufacturers' Code Numbers

CODE	MANUFACTURER
00779	AMP Inc. P.O. Box 3608 Harrisburg, Pa., 17109
01121	Allen-Bradley Co. 1201 2nd St. South Milwaukee, Wi.

Table 6-1. Manufacturers' Code Numbers (Continued)

CODE	MANUFACTURER
01295	Texas Instruments Inc. Semiconductor Group P.O. Box 5012 13500 N. Central Expressway Dallas, Tx., 75222
04713	Motorola Inc. Semiconductor Products Div. 5005 E. McDowell Road Phoenix, Az., 85036
05574	Viking Industries Inc. 21001 Nordhoff St. Chatsworth, Ca., 91311
07263	Fairchild Semiconductor A Div. of Fairchild Camera and Instrument Corp. 464 Ellis St. Mountain View, Ca., 94042
09100	Falling Creek Metal Products Inc. P.O. Box 3747 Laudeen and Grahamwood Drive Richmond, Va., 23234
09922	Burndy Corp. Richards Ave. Norwalk, Ct., 96852
10133	XLO Micromatic 45 E. 48th St. Holland, Mi., 49423
12457	Merrimac Industries Inc. 41 Fairfield Place West Cladwell, N.J., 07006
13103	Thermalloy Co. Inc. P.O. Box 34829 2021 W. Valley View Lane Dallas, TX.
16179	Omni Spectra Inc. 2400 Hollwood Ct. Farmington, Mi., 48024

Table 6-1. Manufacturers' Code Numbers (Continued)

CODE	MANUFACTURER
16681	Greenray Industries Inc. 840 W. Church Rd. Mechanicsburg, Pa., 17055
18324	Signetics Corp. 811 E. Arques Ave. Sunnyvale, Ca., 94086
18612	Vishay Resistor Products Div. Vishay Intertechnology Inc. 63 Lincoln Hwy Malvern, Pa., 19355
22229	Solitron Divices Inc Diodes Integrated Circuits and CMOS 8808 Balboa Ave. San Diego, Ca., 92123
23936	Pamotor Div William J. Purdy Co. 770 Airport Blvd. Burlingame, Ca., 94010
24355	Analog Devices Inc. P.O. Box 280 Rt 1 Industrial Park Norwood, Ma., 02062
25120	Piezo Technology Inc. P.O. Box 7877 2400 Diversifield Way Orlando, Fl., 32804
27014	National Semiconductor Corp. 2900 San Ysidro Way Santa Clara, Ca., 95051
27802	Vectron Laboratories Inc. 121 Water St. Norwalk, Ct., 06854
28480	Hewlett-Packard Co. Corporate HQ. 1501 Page Mill Rd. Palo Alto, Ca., 94304
29593	Bussco Engineering Inc. P.O. Box 652 119 Stanford St. El Segundo, Ca., 90245

Table 6-1. Manufacturers' Code Numbers (Continued)

CODE	MANUFACTURER
31260	Zeta Laboratories Inc. 616 National Ave. Mountain View, Ca., 94043
31356	J-B-T Instruments Inc. 424 Chapel St. P.O. Box 1818 New Haven, Ct., 06508
32293	Intersil Inc. 10900 N. Tantau Ave. Cupertino, Ca., 95014
32997	Bourns Inc. Trimpot Products Div. 1200 Columbia Ave. Riverside, Ca., 92507
33174	Lark Engineering Co. Inc. 866 W. 16th St. Newport Beach, Ca., 92660
50364	Monolithic Memories Inc. 1165 E. Arques Ave. Sunnyvale, Ca., 94086
50522	Monsanto Co. Electronic Special Products 3400 Hillview Ave. Palo Alto, Ca., 94304
50721	Datel Systems Inc. 1020 Turnpike St. Canton, Ma., 02021
70903	Beldon Corp. 2000 S. Batavia Ave. Geneva, Il., 60134
71785	Curtis Marine Co. Norwalk, Va.
74970	Johnson E F Co. 299 10th Ave., S.W. Waseca, Mn., 56093
75382	Kulka Electronic Corp. 633-643 S. Fulton Ave. Mt. Vernon, NY., 10550

Table 6-1. Manufacturers' Code Numbers (Continued)

CODE	MANUFACTURER
80740	Beckman Instruments Inc. 2500 Harbor Blvd. Fullerton, Ca., 92634
85005	Ingersoll Products Div. of Borg-Warner Corp. 1000 W. 120th St. Chicago, Il., 60643
91637	Dale Electronics Inc. P.O. Box 609 Columbus, Ne., 68601
96182	Master Specialties Co. 1640 Monrovia Costa Mesa, Ca., 92627
98734	Hewlett-Packard Co. Mfg. Div. 395 Page Mill Rd. Palo Alto, Ca., 94306

Table 6-2. WJ-1250 A Frequency Synthesizer Assembly, Part Number 702001

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	PART REF NO.
A1	YIG Multiplier Assy		WJ5129-26	7
A2	Power Amplifier	31260	1500-06	8
A3	Power Divider	12457	PDM-30-55	3
A4	Reference Divider and Control Assy		623286-001	12
A5	AGC IF Amplifier Assy		701906-001	15
A6	500 MHz Programmable Divider Assy		701679-001	13
A7	Not Used			
A8	AC Input Filter	28480	HP5060-9421	19
A9	LED Display Assy (6 Digit)		701924-001	35
A10	CCA; Keyboard Assy		701942-002	26
A11	Not Used			
A12	Not Used			
A13	Not Used			
A14	Not Used			
A15	Not Used			
A16	Not Used			
A17	Not Used			
A18	Not Used			
A19	Not Used			
A20	Not Used			

Table 6-2. WJ-1250 A Frequency Synthesizer Assembly, Part Number 702001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	PART REF NO.
A21	CCA; Harmonic Generator Driver & Bias Control		701011-001	58
A22	Not Used			
A23	Not Used			
A24	CCA; Z80 Controller		701932-001	
A25	CCA; Z80 I/O Extender		701936-001	
AT1	Termination; Coax 50 ohm	16179	20020P	27
B1	Blower	23936	8500	20
B2	Same as B1			
CP1	Adapter; Jack/Jack	16179	OSM 209	33
CP2	Adapter; Plug/Plug	16179	OSM 218	28
DS1	Light; Status LOCKED/UNLOCKED	96182	80EA1C3F2(GR)J2 L1N16	32
F1	Fuse; Slow Blow, 2 Amp	10133	313002	84
FL1	Low Pass Filter	33174	LSF200-SAA	14
FL2	100 MHz Band Pass Filter	25120	270VBM	46
J1	Connector Receptacle; 50 pin	71785	DD-50S	64
J2	Connector; BNC		UG-1094	55
J3	Same as J2			
J4	Connector; Rack and Panel	71468	DPXA-A32C2-33S	5
J5	Connector; Receptacle, 9 pin	71785	DE-9P	56

Table 6-2. WJ-1250 A Frequency Synthesizer Assembly, Part Number 702001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	PART REF NO.
PS1	Power Supply		623315-002	6
Q1	Transistor		2N4913	62
R1	Not Used			
R2	Resistor; 5 Ohm, 10 W, 1%	96137	RH-10	61
SA5	Switch; Pushbutton , 5-Position		5F17.5FE WHT2U EE STA4-OAGRA STA5-OARED	168
SA4	Swtich; Pushbutton, 6-Position		6F17.5FE WHT2U GR STA1-EE WHT	169
S1	Switch; POWER	96182	90EA1C5F3J1	30
S2	Switch; INT/EXT	31356	JMT-223	63
S3	Swtich; LOCK/UNLOCK	31356	JMT-123	69
TB1	Terminal Block	75382	599-2003-6	4
TB2	Same as TB1			
TB3	Same as TB1			
W1	RF Cable Assy; Front Panel Jumper		623281-001	51
W2	RF Cable Assy; Flexible		623320-001	73
W3	RF Cable Assy; Flexible		623320-002	74
W4	RF Cable Assy; Flexible		623320-003	76
W5	RF Cable Assy; Flexible		623320-004	77
W6	RF Cable Assy; Flexible		623320-005	78
W7	RF Cable Assy; Flexible		623320-006	79

Table 6-2. WJ-1250 A Frequency Synthesizer Assembly, Part Number 702001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	PART REF NO.
W8	RF Cable; Semi-Rigid		700995-001	67
W9	RF Cable Assy; Flexible		623320-007	82
W10	RF Cable Assy; Flexible		623320-008	81
W11	RF Cable Assy; Flexible		623320-009	80
W12	RF Cable Assy; Flexible		623320-010	83
W13	RF Cable Assy; Flexible		RG 188A/U	120
XA1	Not Used			
XA2	Not Used			
XA3	Not Used			
XA4	Connector; Receptacle	71785	DB-25S	29
XA5	Not Used			
XA6	Not Used			
XA7	Not Used			
XA8	Not Used			
XA9	Connector; Display	05574	3VH25/1JN-5	35
XA10	Not Used			
XA11	Not Used			
XA12	Not Used			
XA13	Not Used			
XA14	Not Used			

Table 6-2. WJ-1250 A Frequency Synthesizer Assembly, Part Number 702001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	PART REF NO.
XA15	Not Used			
XA16	Not Used			
XA17	Not Used			
XA18	Not Used			
XA20	Not Used			
XA21	Connector	09922	PC4DD43-1	17
XA22	Not Used			
XA23	Not Used			
XA24	Connector	27832	EMS068DJ000	167
XA25	Same as XA24			
Y1	5 MHz Crystal Oscillator	27802	C0217-2411	18
Y2	Not Used			
Y3	100 MHz Crystal Oscillator	27802	C0226-2065	68
	Clamp; Round	71785	DD-20964	49
	Clamp; Cable	06383	CLN 5/16	85
	Clamp; Straight	71785	DE-24657	42
	Connector; Plug	71785	DD-50P	48
	Connector; Plug, 9 Sockets	71785	DE-9S	41
	Extender Card		624012-001	151

Table 6-2. WJ-1250 A Frequency Synthesizer Assembly, Part Number 702001 (Concluded)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	PART REF NO.
	Line Cord; 110 VAC	70903	17250	47
	Screw; Lock, Male	71785	D20420-12	50
	Wrench for SMA Connectors		5/16 open end	53

Table 6-3. Reference Divider and Control Circuit Card Assembly A4
Part Number 623286 and 623287

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
AR11	Integrated Circuit	27014*	LM101AH	001 002
AR12	Same as AR11			
C1	Capacitor; .001 μF, 200 V, 10%		CK05BX102K	001 002
C2	Capacitor; .01 μF, 200 V, 10%		CK06BX103K	001 002
C3	Capacitor; .1 μF, 100 V, 10%		CK06BX104K	001 002
C4	Same as C3			
C5	Capacitor; 33 μF, 10 V, 10%		CS13BC336K	001 002
C6	Capacitor; 1 μF, 50 V, 10%		CK06BX105K	002
C7	Same as C6 (002)			
C6	Capacitor; 1 μF, 50 V, 10%	22229	K1W50	001
C7	Same as C6			
C8	Not Used			
C9	Capacitor; 120 pF, 200 V, 10%		CK05BX121K	001 002
C10	Same as C9			
C11	Capacitors; .1 μF, 100 V, 10%			
C11	Same as C3			002
C12	Not Used			
C13	Same as C3			

Table 6-3. Reference Divider and Control Circuit Card Assembly A4 Part Number 623286 and 623287 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
C14	Not Used			
C15	Capacitor; 390 pF, 200 V, 10%		CK05BX391K	001 002
C16	Same as C15			
C17	Same as C6			
C17	Same as C6			
C18	Capacitor; 27 pF, 200 V, 10%		CK05BX270K	001 002
C19	Same as C3			
C20	Same as C18			
C21	Not Used			
C22	Same as C1			
C23	Same as C3			
C24	Capacitor; .01 μF, 200 V, 10%		CK06BX103K	001 002
C25	Same as C24			
C26	Same as C24			
C27	Same as C24			
C28	Same as C24			
C29	Same as C24			
C30	Same as C24			
C31	Same as C24			
C32	Same as C24			

Table 6-3. Reference Divider and Control Circuit Card Assembly A4 Part Number 623286 and 623287 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
C33	Same as C24			
CR1	Diode		1N914	001 002
CR2	Same as CR1			
CR3	Diode, Zener		1N829A	001 002
J1	Connector	71785	DB-25P	001 002
J2	Connector; RF	16179	OSM-211	001 002
J3	Same as J2			
J4	Same as J2			
J5	Same as J2			
L1	Inductor; .22 μH		MS18130-2	001 002
L2	Inductor; 33 μH		MS18130-26	001 002
L3	Same as L2			
Q1	Transistor		2N2222A	001 002
Q2	Not Used			
Q3	Same as Q1			
Q4	Not Used			
Q5	Not Used			
Q6	Same as Q1			
R1	Resistor; 620 Ohm, 1/4 W, 5%		RCR07G621JS	001 002

Table 6-3. Reference Divider and Control Circuit Card Assembly A4
Part Number 623286 and 623287 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
R2	Resistor; 2 K, 1/4 W, 5%		RCR07G202JS	001 002
R3	Resistor; 510 Ohm, 1/4 W, 5%		RCR07G511JS	001 002
R4	Same as R3			
R5	Resistor; 1 K, 1/4 W, 5%		RCR07G102JS	001 002
R6	Not Used			
R7	Not Used			
R8	Resistor; 30 K, 1/4 W, 5%		RCR07G303JS	001 002
R9	Resistor; 10 K, 1/4 W, 5%		RCR07G103JS	001 002
R10	Resistor; 100 K, 1/4 W, 5%		RCR07G104JS	001 002
R11	Not Used			
R12	Not Used			
R13	Not Used			
R14	Resistor; 470 Ohm, 1/4 W, 5%		RCR07G471JS	001 002
R15	Same as R14			
R16	Resistor; 20 K, 1/4 W, 5%		RCR07G203JS	001 002
R17	Resistor; 200 K, 1/4 W, 5%		RCR07G204JS	001 002
R18	Same as R5			
R19	Same as R5			

Table 6-3. Reference Divider and Control Circuit Card Assembly A4
Part Number 623826 and 623287 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
R20	Resistor; 13.3 K, 1/8 W, 1%		RN60C1332F	001 002
R21	Resistor; 1.8 K, 1/4 W, 5%		RCR07G182JS	001 002
R22	Not Used			
R23	Not Used			
R24	Not Used			
R25	Resistor; 360 Ohm, 1/4 W, 5%		RCR07G361JS	001 002
R26	Same as R14			
R27	Same as R14			
R28	Resistor; 3 K, 1/4 W, 5%		RCR07G302JS	001 002
R29	Resistor; 1.5 K, 1/8 W, 1%		RN60C1501F	001 002
R30	Same as R10			
R31	Resistor; 2.2 K, 1/4 W, 5%		RCR07G222JS	001 002
R32	Not Used			
R33	Not Used			
R34	Not Used			
R35	Same as R20			
R36	Not Used			
R37	Same as R29			
R38	Same as R5			

Table 6-3. Reference Divider and Control Circuit Card Assembly A4 Part Number 623286 and 623287 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
R39	Resistor; 150 Ohm, 1/4 W, 5%		RCR07G151JS	001
R40	Resistor; 36 Ohm, 1/4 W, 5%		RCR07G360JS	001
R41	Same as R40			
R42	Same as R10			
R43	Resistor; VAR, 5 K		RJ24FX502	001 002
R44	Resistor; 270 Ohm, 1/4 W, 5%		RCR07G271JS	
R45	Same as R44			
R46	Same as R5			
TP1	Horizontal Jack	74970	105-753	001 002
U1	Integrated Circuit	04713	MC12012L(*)	001 002
U2	Integrated Circuit (001)	04713	MC74901(*)	001
U3	Same as U2 (001)			
U2	Integrated Circuit (002)	01295	SN5490J(*)	002
U3	Same as U2 (002)			
U4	Integrated Circuit (001)	04713	MC40441(*)	001
U4	Integrated Circuit (002)	04713	MC43441(*)	002
U5	Integrated Circuit (001)	07263	7411PC(*)	001
U5	Integrated Circuit (002)	01295	SN5411J(*)	002
U6	Integrated Circuit (001)	07263	9601PC(*)	001
U6	Integrated Circuit (002)	07263	9601DM(*)	002

Table 6-3. Reference Divider and Control Circuit Card Assembly A4
Part Number 623286 and 623287 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
U7	Same as U2 (001)			
U7	Same as U2 (002)			
U8	Integrated Circuit (001)	01295	SN74157N(*)	001
U8	Integrated Circuit (002)	01295	SN54157N(*)	002
U9	Same as U4 (001)			
U9	Same as U4 (002)			
U10	Same as U6 (001)			
U10	Same as U6 (002)			

*NOTE: Alternate parts may be used if approved by QA and R.

Table 6-4. 500 MHz Programmable Divider Assembly A6
Part Number 701679 and 701680-001

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
C1	Capacitor; 33 μF, 10 V		CSR13BC336K	001
C2	Capacitor; 330 pF, 200 V		CK05BX331K	001
C3	Capacitor; 200 V	NOTE 1	CK05BX---K	001
C4	Capacitor; 100 pF, 200 V		CK05BX101K	001
C5	Capacitor; 1000 pF, 200 V		CK05BX102K	001
C6	Capacitor; .01 μF, 200 V		CK06BX103K	001
C7	Same as C5			
C8	Capacitor; 0.1 μF, 50 V		CK05BX104K	001
C9	Same as C5			
C10	Same as C8			
C11	Same as C5			
C12	Same as C8			
C13	Same as C5			
C14	Same as C8			
C15	Same as C5			
C16	Same as C8			
C17	Same as C5			
C18	Same as C8			
CR1	Diode		1N914	001
CR2	Same as CR1			
J1	Connector	71785	DB-25P	001
J2	Connector; RF	16179	OSM 211	001

Table 6-4. 500 MHz Programmable Divider Assembly A6
Part Number 701679 and 701680-001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
J3	Same as J2			
L1	Inductor; 22 μH, 20%		MS18130-2	001
Q1	Transistor (T018)		2N2907	001
R1	Resistor, 150 Ohm, 1/4 W, 5%		RCR07G151JS	001
R2	Same as R1			
R3	Resistor; 36 Ohm, 1/4 W, 5%		RCR07G360JS	001
R4	Resistor; 51 Ohm, 1/4 W, 5%		RCR07G510JS	001
R5	Resistor; 510 Ohm, 1/4 W, 5%		RCR07G511JS	001
R6	Same as R5			
R7	Same as R5			
R8	Same as R5			
R9	Same as R5			
R10	Same as R5			
R11	Same as R5			
R12	Resistor; 180 Ohm, 1/4 W, 5%		RCR07G181JS	001
R13	Same as R5			
R14	Same as R5			
R15	Same as R5			
R16	Same as R5			
R17	Same as R5			
R18	Resistor Network (510 Ohm)	80740	784-1-R510	001
R19	Same as R18			
R20	Same as R18			

Table 6-4. 500 MHz Programmable Divider Assembly A6
Part Number 701679 and 701680-001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
R21	Same as R5			
U1	Integrated Circuit	07263	11C90DC	001
U2	Integrated Circuit	07263	F95010DC	001
U3	Same as U2			
U4	Same as U2			
U5	Same as U2			
U6	Integrated Circuit	50364	6300J	001
U7	Same as U6			
U8	Same as U6			
U9	Same as U6			
U10	Integrated Circuit	07263	F95105DC	001
U11	Same as U10			
	U1 thru U5, U10, U11, Heat Sink (I. C.)	13103	6011B	
	U6 thru U9, Socket I. C.	00779	530177-2	001

NOTE 1: Value is selected at test, Nominal value is 18 pF.

Table 6-5. Six Digit LED Display and Control Circuit Card Assembly A9
Part Number 623306-001

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
C1	Capacitor; 33 μF, 10 V		CS13BC336K	001
C2	Capacitor; .01 μF, 200 V		CK06BX103K	001
C3	Same as C2			
C4	Capacitor; 1 μF, 50 V		CS13BG105K	001
DS1	LED; Amber	50522	MVI	001
DS2	LED; No Decimal Point	98734	5082-7340	001
DS3	LED; R. H. Decimal Point	98734	5082-7300	001
DS4	Same as DS2			
DS5	Same as DS2			
DS6	Same as DS2			
DS7	Same as DS2			
L1	Choke; .22 μH		MS18130-2	001
R1	Resistor; 240 K, 1/4 W, 5%		RCR07G244JS	001
R2	Resistor; 10 K, 1/4 W, 5%		RCR07G103JS	001
R3	Resistor; 200 Ohm, 1/4 W, 5%		RCR07G201JS	001
U1	Integrated Circuit	18324	NE555V	001
U2	Integrated Circuit	07263	7408PC	001
U3	Integrated Circuit	01295	SN74LS32N	001
U4	Same as U3			
U5	Same as U3			
U6	Integrated Circuit	07263	7425DC	001

Table 6-6. Harmonic Generator Driver Circuit Card Assembly A21
Part Number 701011-001

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
AR1	Amplifier	27014	LM101	001 002 003 004
AR2	Same as AR1			
AR3	Same as AR1			
AR4	Same as AR1			
AR5	Same as AR1			
AR6	Amplifier	27014	LM299	002 004
C1	Capacitor; 1 μF, 50 V, 10%		CS13BG105K	001 002 003 004
C2	Same as C1			
C3	Capacitor; 33 μF, 10 V, 10%		CS13BC336K	001 002 003 004
C4	Capacitor; .01 μF, 200 V, 10%		CK06BX103K	001 002 003 004
C5	Capacitor; 1 μF, 50 V	22229	K1W50	001 002 003 004
C6	Same as C5			
C7	Same as C5			

Table 6-6. Harmonic Generator Driver Circuit Card Assembly A21
Part Number 701011-001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
C8	Same as C5			
C9	Same as C5			
C10	Capacitor; 0.1 μF, 100 V, 10%		CK06BX104K	001 002 003 004
C11	Capacitor; 100 pF, 200 V, 10%		CK05BX101K	001 002 003 004
C12	Same as C11			
C13	Capacitor; 1.0 μF, 50 V, 10%		CK06BX105K	001 002 003 004
C14	Same as C13			
C15	Same as C11			
C16	Same as C4			
C17	Same as C11			
C18	Same as C11			
C19	Same as C4			
C20	Same as C4			
C21	Same as C4			
C22	Same as C4			
C23	Same as C4			
C25	Same as C4			
C26	Same as C4			

Table 6-6. Harmonic Generator Driver Circuit Card Assembly A21
Part Number 701011-001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
C27	Same as C4			
C28	Same as C4			
CR1	Diode		1N914	001 002 003 004
CR2	Same as CR1			
CR3	Same as CR1			
CR4	Same as CR1			
CR5	Same as CR1			
L1	Choke; RF, .33 μH		MS18130-3	001 002 003 004
L2	Choke; RF, 3.3 μH		MS18130-14	001 002 003 004
L3	Choke; RF, 33 μH		MS18130-26	001 002 003 004
Q1	Transistor		2N2219	001 002 003 004
Q2	Same as Q1			
R1A	Resistor; Variable, 2 K		RJ24FX202K	001 003
R1B	Same as R1A			

Table 6-6. Harmonic Generator Driver Circuit Card Assembly A21
Part Number 701011-001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
R1C	Same as R1A			
R1D	Same as R1A			
R1E	Same as R1A			
R1F	Same as R1A			
R1G	Same as R1A			
R2A	Same as R1A			
R2B	Same as R1A			
R2C	Same as R1A			
R2D	Same as R1A			
R2E	Same as R1A			
R2F	Same as R1A			
R2G	Same as R1A			
R1A	Resistor; Variable, 2 K	18612	1240X-2K	002 004
R1B	Same as R1A			
R1C	Same as R1A			
R1D	Same as R1A			
R1E	Same as R1A			
R1F	Same as R1A			
R1G	Same as R1A			
R2A	Same as R1A			
R2B	Same as R1A			
R2C	Same as R1A			

Table 6-6. Harmonic Generator Driver Circuit Card Assembly A21
Part Number 701011-001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
R2D	Same as R1A			
R2E	Same as R1A			
R2F	Same as R1A			
R2G	Same as R1A			
R3A	Resistor; Variable, 1 K		RJ24FX102	001 002 003 004
R3B	Same as R3A			
R3C	Same as R3A			
R3D	Same as R3A			
R3E	Same as R3A			
R3F	Same as R3A			
R3G	Same as R3A			
R4	Resistor; 9.5 K, .3 W, 1%	18612	S102-9.5K	001 002 003 004
R5	Resistor; 2.67 K, 1/8 W, 1%		RN60C2671F	001 002 003 004
R6	Resistor; 9.09 K, 1/8 W, 1%		RN60C9091F	001 002 003 004
R7	Resistor; 51.1 Ohm, 1/8 W, 1%		RN60C51R1F	001 002 003 004

Table 6-6. Harmonic Generator Driver Circuit Card Assembly A21
Part Number 701011-001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
R8	Resistor; 20 K, 1/8 W, 1%		RN60C2002F	001 002 003 004
R9	Resistor; 5.11 K, 1/8 W, 1%		RN60C5111F	001 002 003 004
R10	Resistor; 4.7 K, 1/4 W, 5%		RCR07G472JS	001 002 003 004
R11	Same as R10			
R12	Same as R10			
R13	Resistor; 47 K, 1/4 W, 5%		RCR07G473JS	001 002 003 004
R14	Resistor; 3.65 K, 1/8 W, 1%		RN60C3651F	001 002 003 004
R15	Resistor; 52.3 K, .3 W, 1% 5 PPM/°C	18612	V53-1-52.3K	001 002
R16	Resistor; Variable, 5 K	18612	1240X-5X	001 002 003 004
R17	Resistor; 33.2 K, 1/8 W, 1%		RN60C3322F	001 002 003 004
R18	Resistor; 80.6 K, .3 W, 1% 5 PPM/°C	18612	V53-1-80.6K	001 002

Table 6-6. Harmonic Generator Driver Circuit Card Assembly A21
Part Number 701011-001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
R18	Resistor; 80.6 K, .3 W, 1%	18612	S102-80.6K	003 004
R19	Resistor; 9.53 K, 1/8 W, 1%		RN60C9531F	001 002 003 004
R20	Resistor; 1.1 K, 1/4 W, 5%		RCR07G112JS	001 002 003 004
R21	Resistor; 1.74 K, 1/8 W, 1%		RN60C1741F	001 002 003 004
R22	Resistor; 10 K, 1/8 W, 1%		RN60C1002F	001 002 003 004
R23	Resistor; 7.15 K, 1/8 W, 1%		RN60C7151F	001 002 003 004
R24	Resistor; 23.7 K, 1/8 W, 1%		RN60C2372F	001 002 003 004
R25	Resistor; 1 K, 1/4 W, 5%		RCR07G102JS	001 002 003 004
R26	Resistor; 10 Ohm, 1/2 W, 5%		RCR20G100JS	001 002 003 004

Table 6-6. Harmonic Generator Driver Circuit Card Assembly A21
Part Number 701011-001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
R27	Same as R22			
R28	Same as R22			
R29	Same as R22			
R30	Same as R22			
R31	Same as R22			
R32	Resistor; 3.32 K, 1/8 W, 1%		RN60C3321F	001 002 003 004
R33	Same as R22			
R34	Same as R22			
R35	Same as R32			
R36	Same as R25			
R37	Resistor; 51 K, 1/4 W, 5%		RCR07G513JS	001 002 003 004
R38	Same as R37			
R39	Resistor; 4.32 K, 1% 1 PPM/°C	18612	S102-4.32K	003 004
R39	Resistor; 4.32 K, 1% 5 PPM/°C	18612	V53-1-4.32K	001 002
R40	Resistor; 2.37 K, 1% 1 PPM/°C, .3W	18612	S102-2.37K	003 004
R40	Resistor; 2.37 K, 1% 5 PPM/°C, .3W	18612	V53-1-2.37K	001 002
R41	Same as R22			

Table 6-6. Harmonic Generator Driver Circuit Card Assembly A21
Part Number 701011-001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
TP1	Jack; Horizontal	74970	105-758	001 002 003 004
TP2	Jack; Horizontal	74970	105-752	001 002 003 004
TP3	Jack; Horizontal	74970	105-756	001 002 003 004
TP4	Jack; Horizontal	74970	105-757	001 002 003 004
U1	Integrated Circuit	24355	DG508BJ	001 002 003 004
U2	Integrated Circuit	01295	SN74L42N	001 002 003 004
U3	Integrated Circuit	24355	DG201BJ	001 002 003 004
U4	Same as U3			
U5	Same as U3			
U6	Same as U3			
U7	Integrated Circuit	32293	DG141/A	001 002 003 004

Table 6-6. Harmonic Generator Driver Circuit Card Assembly A21
Part Number 701011-001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
U8	Same as U3			
U9	Integrated Circuit	01295	SN74L00N	001 002 003 004
U10	Integrated Circuit	24355	AD562KD/BCD	001 002 003 004
U11	Integrated Circuit	01295	SN74L123N	001 002 003 004
U12	Integrated Circuit	01295	SN74L85N	001 002 003 004
U13	Same as U12			
U14	Same as U12			
U15	Integrated Circuit	01295	SN74L04N	001 002 003 004
U16	Integrated Circuit	07263	96S02	001 002 003 004
U17	Integrated Circuit	50364	6301J	001 002 003 004
U18	Same as U17			

Table 6-6. Harmonic Generator Driver Circuit Card Assembly A21
Part Number 701011-001 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
VR1	Diode		1N825	001 002 003 004

Table 6-7. Z-80 Controller Circuit Card Assembly A24

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
C1	Capacitor; 0.1 μF, 100 V, 10%		CK06BX104K	
C2	Same as C1			
C3	Capacitor; 1.0 μF, 50 V, 10%		CK06BX105K	
C4	Same as C1			
C5	Same as C1			
C6	Same as C1			
C7	Same as C1			
C8	Same as C1			
C9	Capacitor; 4.7 μF, 35 V, 10%		CS13BF475K	
C10	Same as C1			
C11	Same as C1			
C12	Capacitor; 56 pF, 200 V, 10%		CK05BX560K	
L1	Choke; RF, 0.33 μH, 10%		MS18130-3	
Q1	Transistor; NPN, 500 mV, 25 °C	02287	2N2222A	
R1	Resistor; 20 K, 1/4 W, 5%		RCR07G203JS	
R2	Same as R1			
R3	Resistor; 62 K, 1/4 W, 5%		RCR07G623JS	
R4	Resistor; 3 K, S1P	73138	784-1-R3K	
R5	Resistor; 6 K, S1P	73138	784-1-R6K	
R6	Resistor; 12 K, S1P	73138	784-1-R12K	
R7	Same as R6			
R8	Resistor; 5.1 K, 1/4 W, 5%		RCR07G512JS	

Table 6-7. Z-80 Controller Circuit Card Assembly A24 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
R9	Resistor; 6.8 K, 1/4 W, 5%		RCR07G682JS	
R10	Resistor; .33 K, 1/4 W, 5%		RCR07G331JS	
R11	Same as R4			
R12	Same as R5			
R13	Same as R6			
R14	Resistor; 1 K, 1/4 W, 5%		RCR07G102JS	
U1	Integrated Circuit; DIP	07263	96L02	
U2	Integrated Circuit; DIP	50364	6301	
U3	Integrated Circuit; DIP	01295	SN74LS257N	
U4	Same as U3			
U5	Integrated Circuit; DIP	(Note 1)	Z-80 PIO	
U6	Same as U5			
U7	Integrated Circuit; DIP	(Note 1)	Z-80 CPU	
U8	Integrated Circuit; DIP	04713	MC4024P	
U9	Integrated Circuit; DIP	01295	SN7404N	
U10	Same as U9			
U11	Integrated Circuit; DIP	50364	6305-1J	
U12	Same as U11			
U13	Integrated Circuit; DIP	34649	2112A-4	
U14	Integrated Circuit; DIP	01295	SN7400N	
U15	Integrated Circuit; DIP	01295	SN75138N	
U16	Same as U15			

Table 6-7. Z-80 Controller Circuit Card Assembly A24 (Continued)

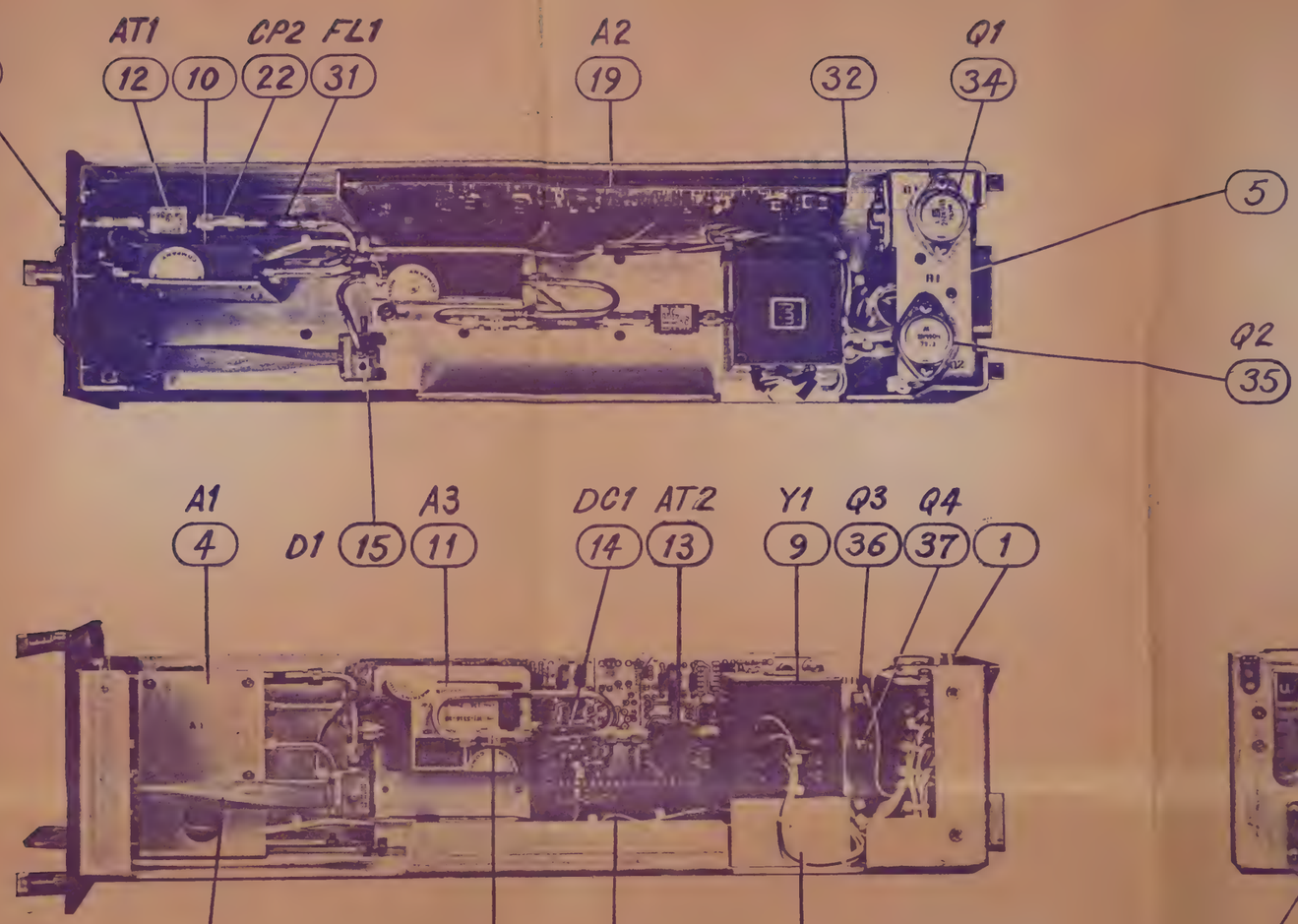
REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
U17	Integrated Circuit; DIP	56289	UHP402	
U18	Integrated Circuit; DIP	01295	SN74LS138N	
U19	Integrated Circuit; DIP	01295	TID130N	
U20	Rocker DIP Switch (SPST); 20 pin	00779	435166-7	
U21	Same as U13			
U22	Same as U11			
U23	Same as U11			
U24	Same as U18			
	Note 1: Mfr. - Zilog Company 10460 Bubb Road Cupertino, Ca. 95014			

Table 6-8. Z-80 I/O Extender Circuit Card Assembly A25

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
C1	Capacitor; 4.7 μF, 35 V		CS13BF475K	
C2	Same as C1			
C3	Capacitor; 4.7 μF, 10 V		CS13BC475K	
C4	Capacitor; 0.1 μF, 100 V, 10%		CK06BX104K	
C5	Same as C4			
C6	Same as C4			
C7	Same as C4			
C8	Same as C4			
L1	Choke; RF, 33 μH, 10%		MS18130-26	
L2	Same as L1			
L3	Choke; RF, .33 μH, 20%		MS18130-3	
R1	Resistor; Variable, 10 K		RJ24FX103	
R2	Same as R1			
R3	Resistor; 1 M, 1/4 W, 5%		RCR07G105JS	
R4	Resistor; 200 K, 1/4 W, 5%		RCR07G204JS	
U1	Integrated Circuit; DIP	50507	MN328	
U2	Integrated Circuit; DIP	50364	6305-1J	
U3	Same as U2			
U4	Same as U2			
U5	Same as U2			
U6	Integrated Circuit; DIP	01295	SN74LS279	
U7	Integrated Circuit; DIP	01295	SN74367	

Table 6-8. Z-80 I/O Extender Circuit Card Assembly A25 (Continued)

REF DESIG	DESCRIPTION	MFG CODE	PART NO.	APPL TO
U8	Integrated Circuit; DIP	01295	SN74LS138	
U9	Integrated Circuit; DIP	01295	SN74L04	
U10	Integrated Circuit; DIP	56289	UPH402	
U11	Integrated Circuit; DIP	56289	UPH432	
U12	Integrated Circuit; DIP	01295	SN72558	
U13	Integrated Circuit; DIP	(Note 1)	Z-80 PIO	
U14	Same as U13			
U15	Same as U13			
U16	Same as U13			
U17	Same as U13			
U18	Same as U13			
U19	Integrated Circuit; DIP	13919	DAC70C-CCD-I	
	Note 1: Mfr: - Zilog Company 10460 Bubb Road Cupertino, Ca. 95014			



NOTES: UNLESS OTHERWISE SPECIFIED

QTY REQD	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	ITEM NO.

PARTS LIST

	WJ-1251-9A
NEXT ASSY	USED ON
APPLICATION	

UNLESS OTHERWISE SPECIFIED

DIMENSIONS ARE IN INCHES
TOLERANCES ARE:

DECIMALS	ANGLES
.XXX ±	±
.XX ±	
.X ±	

✓

INTERPRET DRAWING PER WJ STANDARD 620000

DO NOT SCALE DRAWING

CONTRACT NO.

APPROVALS		DATE
DR	Ralph Tinus	5/29/80
CHK		
APPD		
APPD		
APPD		

WATKINS • JOHNSON COMPANY
PALO ALTO, CALIFORNIA

RF SOURCE
18-26.5 GHZ

SIZE	CODE IDENT NO.	
C	14482	700024-002

SCALE | SHEET OF

PARTS LIST

WATKINS • JOHNSON COMPANY

PALO ALTO, CALIFORNIA

14482	PL 700024-002
CODE IDENT	SHEET 1 OF 4

PREPARED BY: NJM	DATE	CONTRACT NO.
CHECKED BY:		
APPROVED BY:		INTERPRET DRAWING PER WJ STANDARD 620000
APPROVED BY:		
APPROVED BY:		

TITLE

18 - 26.5 GHz RF SOURCE.

NEW DESIGN.

REV	REVISION DESCRIPTION	DATE	APPROVED

NOTES: UNLESS OTHERWISE SPECIFIED

PRIMARY ENGINEERING RECORD DRAWING

ALL DEVIATIONS MUST BE APPROVED BY THE PROJECT ENGINEER AND TO BE RECORDED ON THIS DRAWING. WHICH IS TO REMAIN WITH THE ITEM. ALL CHANGES MUST BE MARKED IN RED.

PROGRAM WJ-1251-XX MODEL 1251-9

PROJECT ENGINEER NJM DATE 10/25/80

FINAL CONFIGURATION APPROVAL

PROJECT ENGINEER _____ _____

700024-002	WJ-1251-92
NEXT ASSY	USED ON
APPLICATION	

QTY REQ -002	QTY REQ -001	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	REFERENCE DESIGNATION	ITEM NO.
	1		700151-	CHASIS, ELECTRICAL EQUIPMENT			1
	1		700152-	PANEL, FRONT			2
	1		623273-001	BRACKET, OSCILLATOR MOUNTING.			3
	1		624305-001	BRACKET, MIXER MOUNTING			4
	1		624275-001	BRACKET, HEAT SINK			5
	1		700164-	COVER, TOP			6
	1		700159-001	BRACKT, W/G ADAPTER SUPPORT			7
	1		WJ 5008-95	OSCILLATOR, 9-13.25 GHz	Ref	Y1	9
	1		WJ C27-2	CONVERTOR,	Ref	A1	10
	1		WJ 5316-XX	AMPLIFIER	Ref	A3	11
	1	16453	2JC-8016 Western M/W (INPUT-MALE OUTPUT-MALE)	ISOLATOR, WITH CONNECTORS INPUT – SMA MALE OUTPUT – SMA MALE.		AT1	12

PARTS LIST

WATKINS · JOHNSON COMPANY

PALO ALTO, CALIFORNIA

14482 CODE IDENT

PL 700024-002 SHEET 2 OF 4

QTY REQD -002	QTY REQD -001	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	REFERENCE DESIGNATION	ITEM NO.
	1	16453	2 JC 8016 WESTERN M/W	ISOLATOR, 8-16 GHz WITH CONNECTORS		AT2	13
			(INPUT- FEMALE OUTPUT- MALE)	INPUT - FEMALE OUTPUT - MALE			
	1		4055-10 NARDA	DIRECTIONAL COUPLER		DC1	14
	1		DK-1 WITH HIGH POWER DIODE	FREQUNCY DOUBLER WITH HIGH POWER DIODE	✓	D1	15
	1		333	ATTENUATOR, 6DB		AT3	16
	1		700154-001	ADAPTER, WAVEGUIDE OUTPUT		CP7	17
	1		599-2003-6	TERMINAL BLOCK		TB1	18
	1		701451-013	CCA, RF SOURCE		A2	19
	2		623280-001	RAIL GUIDE			20
	1		700293-001	LABLE			21
	4	16179	05M 218	ADAPTER, PLUG/PLUG		CP2-CP5	22
	1	09922	PC4DD43-1	CONNECTOR, CCA RECEPTACLE		XA2	23
	1	71468	DPXA-A32C2 34P	CONNECTOR, MALE RECEPTACLE		J1	24

QTY REQ -002	QTY REQ -001	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	REFERENCE DESIGNATION	ITEM NO.
	1		DBE-274	WAVE GUIDE, 4" LONG		CP6	25
	1	83330	1636	HANDLE			26
	1		ST69513	NAME PLATE			27
	1	29593	B5286	GROUND TREE		WT1	28
		83330	8481	SPACER, CLEAR NO 4, 0.250 LONG			29
			OSM 209	ADAPTER		CP1	30
	1		4L250-X18000	LOW PASS FILTER		FL1	31
	2		624272-001	BRACKET VERTICAL CARD GUIDE			32
		91637	RH-10	RESISTOR, 5 OHMS 10 W 1 PCT			33
			2N 4913	TRANSISTOR		Q1	34
			2N 4904	TRANSISTOR		Q2	35
			2N 4910	TRANSISTOR		Q3	36
			2N 4898	TRANSISTOR		Q4	37

PARTS LIST

WATKINS · JOHNSON COMPANY
PALO ALTO, CALIFORNIA

14482 (CODE IDENT)

PL 700024-002

SHEET 4 OF 4

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	PER ECO 1251-0 [illegible]	JAN 6 1977	[illegible]
B	REV PER ECO 1251-0125	MAY 1977	[illegible]

CKT CARD ASSY
RF SOURCE CONTROL
701451

FINE TUNE VOLTAGE

FM MODE COMMAND

EXTERNAL FM SIGNAL

COARSE TUNE VOLTAGE 1V/GHz

HOLDOFF

DETECTOR VIDEO (~300M.;MW.REG)

VR(+)

GND

LEVEL MIN
LEVEL REF
LEVEL MAX

VR(-)

DET VIDEO IN 1-4

DET VIDEO IN 1-1

BREAKPOINT COMMAND (1 GHz)

.22, 1/8W, 1% R1 [3] R3, 1/8W, 1%
C1, 8200PF
L1 330MH, 5%
U1F U2
R4, 1MEG
C2 .01 R5 5K R6 5K
R7 50K C3 270PF
+15V R66 390
AR1
R14 1/8W 1% [3] R67 390
-15V
C4 33PF
CR1 IN914
CR2 IN914
Q1 2N2219 R17, 68 Q3 2N2905 R19, 30K CR3 IN914 R23, 6.2K +15V R24, 6.2K Q5 2N2219
Q2 2N2905 R18, 68 R21, 6.2K Q4 2N2219 Q6 2N2905
C6, 1000PF [15] R15, 3.9K R16 39, 5W R20, 30K CR4 IN914 R22, 6.2K -15V
TP1
+15V R11, 510 R10 2K CR5 IN914 AR2A R8, 100K
R9, 100K CR6 IN914 AR2B
-15V R12, 510
R13, 5.1K +5V
C7, 1
FM CKT [15]
FINE TUNE DRIVER CKT
L6 33UH C26 1/50V L7 33UH C27 1/50V
L2 .22UH C22 .01 C21, 33 10VDC L3 33UH C23 1/50VDC L4 33UH C24 1/50VDC L5 33UH C25 1/50VDC
+15V +5V -15V +15V +28V
FINE TUNE COIL (-) FINE TUNE COIL (+)
+15V -15V
Q1 TUNING COIL (+) TUNING COIL (-)
GND ANALOG GND
+15V
TP1 TP2 TP3 TP4 TP5 TP6 TP7

COARSE TUNE DRIVER CKT
R26 [3] R27 1/8W, 1% R25, 20K 1/8W, 1%
VR8 [14] R71 [14] VR7 [14] R70 [14] C8 1, 100V
R35, 20K 1/8W, 1%
AR3
R28 20K 1/8W, 1% [4]
R30 8.45K 1/8W, 1% [4] R29 1.43K 1/8W, 1% R31 11K
VR1 IN825
R33 [3] 1/8W, 1% R34 [3]
R32, 2K -15V
R36 10K
AR4
R33, 10K 1/8W, 1% +15V
R37 Q7 2N2219 [3] [13]
C10 1000PF
C11 1
U3
R39 5.1K CR7 IN914
R40 5.1K CR8 IN914
R64 1K
HOLDOFF

POSITIVE BIAS CKT [6]
R50, 10K 1/8W, 1% R51 50K
AR5
VR4 IN755
R56 5.1K R65 200 1W
C30 10UF 50V
Q8 2N5681 (HEATSINK)
VR3 IN747A C15 1 R52, 10K 1/8W, 1% R53, 2K -15V
C16 6800 PF
R54, 20K R55, 10K 1/8W, 1%
C17 1, 50VDC
+28V R48 348 1/2W, 1% R49 1.1K 1/2W, 1% (HEATSINK) Q10 2N5681 [10]
R42, 10K R41 10K C12 .01 [9]
LEVELING CKT [5]
R68, 100 +15V C28, .1
AR7
R47, 1.5K R46, 523K, [9] 1/8W, 1% R45 2K -15V
VR2 IN825 C14 1
R44 10K, 1/8W, 1%
R69, 100 -15V C29, .1
C13 100PF
R43, 499 1/8W, 1% [9]
CONTROL CURRENT TO PIN SWITCH
+20.5V BIAS
POSITIVE BIAS
REGULATED BIAS (+)
GND

NEGATIVE BIAS CKT [7]
R57, 10K 1/8W, 1% [8] R58 20K
AR6
VR6 IN753
R63 2K
Q9 2N2905
VR5 IN825 C18 1 R59, 10K 1/8W, 1% R60, 2K +15V
R62 [3] 1/8W, 1% R61 [3]
C19 6800PF
C20 1, 50VDC
[12] K1
+15V CR9 IN914
SWITCHED DET. VIDEO OUT
VR(-) NEG BIAS
REG. 9.1V (-) TO OSC

OPTION TABLE

SOURCE	BAND	ASSY	R1	R2	R3	R4	R26	R27	R33	R34	R37	R61	R62	VR(+)	VR(-)
1251-1	.5-1.0	-001,-002	1.0K	3.09K	3.09K	4.99K	10K	30.1K	181K	50K	15K	—	—	—	—
-2	1-2	-003,-004	1K	3.09K	3.09K	4.99K	10K	30.1K	61.9K	20K	10K	—	—	—	—
-3	2-4	-005,-006	1.5K	3.09K	3.09K	4.99K	10K	30.1K	30.1K	10K	10K	—	—	—	—
-4	4-8	-007,-008	2K	5.49K	5.49K	4.99K	5K	8.25K	59.0K	15K	1K	5K	7.5K	+23.	-5V
-5	8-12.4	-009,-010	5K	1.35K	5.6K	2K	5K	9.09K	237K	5K	2K	20K	.5K	—	-20V
-6	12.4-18	-011,-012	5K	5.6K	5.6K	2K	5K	9.09K	15K	5K	2K	20K	10K	—	-20V
-7	8-18	-013,-014	5K	1.35K	5.6K	2K	5K	9.09K	237K	5K	2K	20K	10K	—	-20V
-8	1-4	-015,-016	2K	3.09K	3.09K	4.99K	5K	14.7K	59.0K	50K	[13]			—	—
-12	0.1-4	-017,-018	10K	3.09K	3.09K	4.99K	5K	14.7K	150K	50K	[13]			—	—
-13	3.7-8.4	-019,-020	10K	5.49K	5.49K	4.99K	5K	8.25K	56.2K	10K	1K	5K	7.5K	+28V	-5V
1251-20	7-11	-021,-022	5K	1.58K	1.58K	2K	5K	9.09K	27.4K	5K	[3]	20K	10K	—	-20V
1251-25	9.2-10.2	-023,	5K	1.58K	1.56K	2K	5K	9.09K	20K	5K	2K	20K	10K	—	-20V

NOTES: UNLESS OTHERWISE SPECIFIED
1. RESISTANCE IS IN OHMS, 1/4W, 5%.
2. CAPACITANCE IS IN MICROFARADS, 200V, 10%.
3. SEE OPTION TABLE FOR VALUES.
4. USED ONLY ON 1251-12 SOURCE, (ASSY'S -017 & -018.)
5. THIS CKT INCLUDED ONLY WHEN LEVELING IS ORDERED AS AN OPTION. EVEN Nº ASSY'S ONLY.
6. THIS CKT USED ONLY ON 1251-4 & 1251-13, (ASSY'S -007, -008, -019, & -020.)
7. THIS CKT INCLUDED ONLY IN ASSY'S -001 THRU -014, AND -019 THRU -023.
8. USED ON ASSY'S -009 THRU -014, & -021 THRU -023 ONLY
9. NOMINAL VALUE SHOWN. FINAL VALUE DETERMINED IN TEST
10. USED ONLY ON ASSY'S -001 THRU -006.
11. IN ASSY'S -007, -008, -019, & -020 REPLACE R58A (ITEM 64) WITH R58B (ITEM 117) SEE PL 701451.
12. USED ONLY ON ASSY'S -017, -018
13. ON ASSY'S -015 THRU -018, -021 & -022, R37 IS REPLACED WITH JUMPER WIRE (ITEMS 151 & 152) SEE PL 701451.
14. OPTIONAL COMPONENTS. TO BE DETERMINED IN TEST
15. THIS CKT INCLUDED ONLY WHEN FM IS ORDERED AS AN OPTION TO ALL ASSY'S. WHEN FM CKT IS NOT ORDERED, A JUMPER WIRE (ITEMS 151 & 152, PL 701451) MUST BE INSTALLED BETWEEN SOLDER PADS U2-7 & U2-8, AND A JUMPER WIRE INSTALLED ACROSS C5.

COMPONENT REF. DESIG.		
FIRST	LAST	DELETED
AR1	AR7	–
C1	C29	–
CR1	CR9	–
L1	L7	–
Q1	Q10	–
R1	R71	–
U1	U3	–
VR1	VR8	–
K1	K1	–
TP1	TP7	–

INTEGRATED CIRCUIT IDENTIFICATION TABLE						
REF. DESIG.	TYPE	+5V	VCC	GND	-15V	CKT
AR2, 3, 4	[illegible]		–	–	–	
AR5	[illegible]	–	–	–	–	
AR6	[illegible]	–	–	–	–	
U1	[illegible]	–	[illegible]	–	–	
U2, U3	[illegible]	[illegible]	–	[illegible]	[illegible]	

QTY PER	CODE IDENT	PART OR IDENTIFYING NO.	NOMENCLATURE OR DESCRIPTION	SPECIFICATION	ITEM NO.

PARTS LIST

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ARE:
DECIMALS ANGLES
.XXX ± °
.XX ± '
.X ± "
INTERPRET DRAWING PER WJ STANDARD 6.0000
DO NOT SCALE DRAWING

CONTRACT NO.
APPROVALS DATE
DR T. CROSHAW 6-3-76
CHK [illegible] 6/9/76
APPD
APPD
APPD

WATKINS-JOHNSON COMPANY
PALO ALTO, CALIFORNIA

SCHEMATIC DIAGRAM
RF SOURCE CONTROL

NEXT ASSY	USED ON
APPLICATION	

701451 WJ1251

SIZE E | CAGE IDENT NO. 14482 | 701454

SCALE [illegible] SHEET OF

SOURCE

RF SOURCE OSCILLATOR MATRIX

SOURCE & OSCILLATOR	CONNECT Y1-1 TO	CONNECT Y1-2 TO	CONNECT Y1-3 TO	CONNECT Y1-4 TO	CONNECT Y1-5 TO	CONNECT Y1-6 TO	CONNECT Y1-7 TO	CONNECT Y1-8 TO
WJ-1251-25 (9.2-10.2 GHz)	Q1-E	R1-1	Q2-E	NC	NC	WT1	XA2-9	Q3-E
WJ-5008-111 (702051-001								
WJ-1251-9 M(7-25.5GHz)								
WJ-5008-35	Q1-E	R1-1	Q2-E	NC	NC	WT1	XA2-9	Q3-E

WATKINS-JOHNSON CO. 3333 HILLVIEW AVENUE PALO ALTO CALIFORNIA

CODE IDENT	DIV	NO.	SHEET
14482		WL700511	4

WJ-1395

RF SOURCE OSCILLATOR MATRIX

SOURCE & OSCILLATOR	CONNECT Y1-1 TO	CONNECT Y1-2 TO	CONNECT Y1-3 TO	CONNECT Y1-4 TO	CONNECT Y1-5 TO	CONNECT Y1-6 TO	CONNECT Y1-7 TO	CONNECT Y1-8 TO
WJ-1251-1 (0.5-1 GHz)	Q1-E	R1-1	XA2-9	WT1	Q3-E	TB1-1	WT1	TB1-3
WJ-571-83								
OMNIYIG YOP-20	Q1-E	R1-1	XA2-9	Q3-E	WT1	XA2-84	TB1-1	WT1
WJ-1251-2 (1-2 GHz)	Q1-E	R1-1	Q3-E	WT1	XA2-9	TB1-1	WT1	TB1-3
WJ-5189-83								
OMNIYIG YOL-20	Q1-E	R1-1	XA2-9	Q3-E	WT1	XA2-84	TB1-1	WT1
WJ-1251-3 (2-4 GHz)	Q1-E	R1-1	Q3-E	TB1-1	XA2-9	WT1	WT1	TB1-3
WJ-5122-83								
OMNIYIG YOS-20	Q1-E	R1-1	XA2-9	Q3-E	WT1	XA2-84	TB1-1	WT1
WJ-1251-4 (4-8 GHz)	XA2-82	Q2-E	XA2-9	Q3-E	Q1-E	R1-1	TB1-1	WT1
AVANTEK ASF9894-M								
AVANTEK AV7403-M	TB1-3	Q2-E	XA2-9	Q3-E	Q1-E	R1-1	TB1-1	WT1
WJ-1251-5 (8-12.4 GHz)	Q1-E	R1-1	Q2-E	N.C.	N.C.	WT1	XA2-9	Q3-E
WJ-5008-83								
WJ-1251-6 (12.4-18 GHz)	Q1-E	R1-1	Q2-E	N.C.	N.C.	WT1	XA2-9	Q3-E
WJ-5041-83								
WJ-1251-7 (8-18 GHz)	Q1-E	R1-1	Q2-E	N.C.	N.C.	WT1	XA2-9	Q3-E
WJ-5156-83								
WJ-1251-8 (1-4 GHz)	Q1-E	R1-1	XA2 9	Q3-E	WT1	TB1-2	TB1-1	WT1
OMNIYIG YOM 24B								
WJ-1251-12 (0.1-4 GHz)	Q1-E	R1-1	XA2-9	Q3-E	WT1	TB1-2	TB1-1	WT1
OMNIYIG YOM 24B	Q1-E	R1-1	XA2-9	Q3-E	WT1	TB1-2	TB1-1	WT1
OMNIYIG YOM 63								
WJ-1251-13 (3.7-8.4 GHz)	XA2-82	Q2-E	XA2-9	Q3-E	Q3-E	R1-1	TB1-1	WT1
AVANTEK ASF9894-M								

WATKINS JOHNSON COMPANY 3333 HILLVIEW AVENUE PALO ALTO CALIFORNIA

CODE IDENT	DIV	NO.	SHEET
14482		WL700511	3

WJ-1395

APPLICATION		REVISIONS				
NEXT ASSY	USED ON	LTR	DESCRIPTION		DATE	APPROVED
—	WJ1251-*	A	ECO 1251-0066	S.M.	9/16/76	
		B	ECO 1251-0110		7/5/77	
		C	ECO 1251-0111		7/5/77	
		D	ECO 1251-124	WM	9-14-77	

NOTES: UNLESS OTHERWISE SPECIFIED

[1] DELETE for -001 VERSION ON ALL SOURCES.

[2] INSTALL ACCORDING TO THE FOLLOWING RF SOURCE BAND CODE MATRIX:

RF SOURCE	CONNECT J1-19 TO	CONNECT J1-18 TO	CONNECT J1-22 TO	CONNECT J1-21 TO	CONNECT J1-20 TO
1251-9	TB1-4	TB1-4	WT1	WT1	WT1
1251-1	TB1-4	TB1-4	WT1	WT1	WT1
1251-2	TB1-4	TB1-4	WT1	WT1	TB1-4
1251-3	TB1-4	TB1-4	WT1	TB1-4	WT1
1251-4	TB1-4	TB1-4	WT1	TB1-4	TB1-4
1251-5	TB1-4	TB1-4	TB1-4	WT1	WT1
1251-6	TB1-4	TB1-4	TB1-4	WT1	TB1-4
1251-7	TB1-4	WT1	WT1	TB1-4	WT1
1251-8	TB1-4	WT1	WT1	WT1	WT1
1251-12	TB1-4	WT1	TB1-4	WT1	WT1
1251-13	WT1	WT1	WT1	WT1	WT1
1251-25	TB1-4	TB1-4	TB1-4	TB1-4	WT1

USE 24 AWG YELLOW WIRE FOR CONNECTIONS TO TB1-4.
USE 22 AWG BLACK WIRE FOR CONNECTIONS TO WT1.

[3] INSTALL ACCORDING TO OSCILLATOR MATRIX ON SHEET 3 & 4

USE 22 AWG BLACK WIRE FOR CONNECTIONS TO WT1
USE 24 AWG VIOLET WIRE FOR CONNECTIONS TO TB1-1
USE 24 AWG RED WIRE FOR CONNECTIONS TO TB1-2
USE 24 AWG WHT/RED WIRE FOR CONNECTIONS TO TB1-3
USE 24 AWG WHITE WIRE FOR ALL OTHER CONNECTIONS

[4] DELETE FOR 1251-1, 1251-2, 1251-3, 1251-8 AND 1251-12 RF SOURCES.

[5] INSTALL ONLY ON 1251-4 AND 1251-13 RF SOURCES

6. THIS IS A DOUBLE ENDED WIRE LIST. INSTALL NUMBERED WIRES ONLY.

[7] DELETE FOR 1251-1, 1251-2, 1251-8 AND 1251-12 RF SOURCES.

[8] INSTALL ONLY ON 1251-12 RF SOURCE.

[9] DELETE FOR 1251-12 RF SOURCE ONLY.

[10] INSTALL ONLY ON 1251-25 RF SOURCE.

WATKINS JOHNSON COMPANY

CODE IDENT	DIV	NO.	SHEET
14482		WL700511	2

REV			
SHEET			
REV STATUS			
OF SHEETS			

UNLESS OTHERWISE SPECIFIED	CONTRACT NO	WATKINS · JOHNSON COMPANY ELECTRON DEVICES ELECTRONIC SYSTEMS PALO ALTO CALIFORNIA		
XX DEC ±	DO NOT SCALE DRAWING	WIRE LIST, RF SOURCES		
XXX DEC ±	DR R. HILLANDER 4-2-76			
FRACTIONS ±	CHK R. Hillander 4-6-76			
ANGLES ± —	APPD 4-8-76	SIZE A	CODE IDENT NO 14482	WL700511
FINISH — RMS	APPD	SCALE —	SHEET 1 OF 12	

WL T216

WJ-1281

WATKINS-JOHNSON COMPANY

WIRING LIST

WIRE NO.	DESCRIPTION: GAGE	DESCRIPTION: COLOR: BODY	DESCRIPTION: COLOR: 1st TCR	DESCRIPTION: COLOR: 2nd TCR	ITEM NO.	FROM: SYMBOL	FROM: TERM. ITEM NO.	FROM: CIRCUIT POINT	FROM: STATION NO.	TO: STATION NO.	TO: CIRCUIT POINT	TO: TERM. ITEM NO.	TO: SYMBOL	REMARKS	FUNCTION
76								Y1-7			NOTE [3]				
77								Y1-8			NOTE [3]				
78	22	O						Y1-9			WT1			NOTE [5]	GROUND
79	24	9	2					TB1-3			AR2+15			NOTE [8]	+15V
80	22	4						A5-(+5)			TB1-4			NOTE [10]	+5V
81	22	O						A5-LUG			WT1			NOTE [10]	GND

TITLE:	SIZE	CODE IDENT NO.	WL	REV
	A	14482	700 511	
			SHEET 12	

OCT 25 1982

WIRE NO.	DESCRIPTION				ITEM NO.	FROM				TO				REMARKS	FUNCTION
	GAGE	COLOR				SYMBOL	TERM. ITEM NO.	CIRCUIT POINT	STATION NO	STATION NO.	CIRCUIT POINT	TERM. ITEM NO.	SYMBOL		
		BODY	1st TCR	2nd TCR											
54	22	2						VR1-3			TB1-2			NOTE [8]	+28V
	24	9						XA2-2			Q3-B				FINE TUNE
	24	9						XA2-4			Q4-B				FINE TUNE
55	22	0						XA2-5			WT1				GROUND
56	22	9	7					XA2-6			TB1-5				-15V
	24	9						XA2-9			NOTE [3]				FINE TUNE (+)
57	22	9	2					XA2-10			TB1-3				+15V
58	22	4						XA2-14			TB1-4				+5V
								XA2-16			N/C				FM LOCK
								XA2-20			N/C				FM MODE
								XA2-22			N/C				EXT FM
	24	9						XA2-24			J1-15				FINE TUNE IN
	24	9						XA2-30			R2-3			NOTE [1]	LEVEL MAX
	24	9						XA2-32			R2-1			NOTE [1]	LEVEL MIN
59	22	0						XA2-33			WT1				GROUND
	—							XA2-34			CR1-J2			[1] [9] RG-188	DET VIDEO IN
60	24	9						XA2-34			XA2-76			NOTE [8]	DET VIDEO IN

TITLE:	SIZE	CODE IDENT NO.	WL	REV
	A	14482	700511	
				SHEET 9

MATHES JOHNSON COMPANY

WIRING LIST

WIRE NO	DESCRIPTION				ITEM NO.	FROM				TO				REMARKS	FUNCTION
	GAGE	COLOR BODY	COLOR 1st TCR	COLOR 2nd TCR		SYMBOL	TERM. ITEM NO	CIRCUIT POINT	STATION NO	STATION NO.	CIRCUIT POINT	TERM. ITEM NO	SYMBOL		
	24	9						XA2-36			R2-2			NOTE [1]	LEVEL REF
	24	9						XA2-38			S2-1			NOTES [1] [9]	PIN CONTROL
	—							XA2-38			S2-J3			[8] RG-188	PIN CONTROL
61	22	0						XA2-45			WT1				GROUND
	24	9						XA2-52			R1-2				D/A GROUND
	24	9						XA2-54			J1-17				HOLDOFF
	24	9						XA2-56			J1-16				HOLDOFF
	24	9						XA2-62			Q1-B				COARSE TUNE
	24	9						XA2-64			R1-1				MAIN COIL (-)
	24	9						XA2-66			S3-2			NOTES [1] [8]	DET VIDEO (1-4)
	24	9						XA2-67			J1-10				D/A INPUT
	24	9						XA2-68			Q2-B			NOTE [4]	NEG BIAS
	24	9						XA2-69			Q2-E			NOTE [4]	REG BIAS (-)
62	22	9	7					XA2-70			TB1-5				-15V
63	22	5						XA2-72			TB1-6				VR (-)
64	22	9	2					XA2-73			TB1-3				+15V
	—							XA2-74			CR3-J2			[8] RG-188	DET VIDEO (.1-1)

TITLE:	SIZE	CODE IDENT NO.	WL	REV
	A	14482	700511	

WATKINS-JOHNSON COMPANY

WIRING LIST

WIRE NO.	DESCRIPTION				ITEM NO	FROM				TO				REMARKS	FUNCTION
	GAGE	COLOR				SYMBOL	TERM. ITEM NO	CIRCUIT POINT	STATION NO.	STATION NO	CIRCUIT POINT	TERM ITEM NO.	SYMBOL		
		BODY	1st TCR	2nd TCR											
	24	9						XA2-7[illegible]			XA2-34			NOTE [8]	DET VIDEO
65	22	0						XA2-77			WT1				GROUND
	24	9						XA2-78			J1-13			NOTE [8]	BREAK POINT
	24	9						XA2-78			S1-2			NOTE [8]	BREAK POINT
66	22	2						XA2-80			TB1-2				VR(+)
	24	9						XA2-82			NOTE [3]				POS BIAS
67	24	9						XA2-82			XA2-83				REG BIAS(+)
	24	9						XA2-83			XA2-82				REG BIAS(+)
	24	9						XA2-84			NOTE [3]				+20.5V BIAS
68	22	0						XA2-85			WT1				GROUND
69	22	2						XA2-86			TB1-2				+28V
70								Y1-1			NOTE [3]				
71								Y1-2			NOTE [3]				
72								Y1-3			NOTE [3]				
73								Y1-4			NOTE [3]				
74								Y1-5			NOTE [3]				
75								Y1-6			NOTE [3]				

TITLE:	SIZE	CODE IDENT NO.	WL	REV
	A	14482	700511	
				S

WATKINS-JOHNSON COMPANY

WIRING LIST

WIRE NO.	DESCRIPTION GAGE	COLOR BODY	COLOR 1st TCR	COLOR 2nd TCR	ITEM NO.	FROM SYMBOL	FROM TERM. ITEM NO.	FROM CIRCUIT POINT	FROM STATION NO	TO STATION NO	TO CIRCUIT POINT	TO TERM. ITEM NO.	TO SYMBOL	REMARKS	FUNCTION
	24	9						R1-1			NOTE [3]				MAIN COIL (-)
	24	9						R1-2			J1-9				D/A GND
42	24	9						R1-2			XA2-52				D/A GND
43	22	O						R1-2			WT1				D/A GND
44	24	9						R2-1			XA2-32			NOTE [1]	LEVEL MIN
45	24	9						R2-2			XA2-36			NOTE [1]	LEVEL REF
46	24	9						R2-3			XA2-30			NOTE [1]	LEVEL MAX
47	—							S1-J3			S2-2			[1][9] RG-188	PIN CONTROL
48	24	2						S1-1			TB1-2			NOTE [8]	+28V
49	24	9						S1-2			XA2-78			NOTE [8]	BREAK POINT
50	24	9						S2-1			XA2-38			NOTES [1][9]	PIN CONTROL
	—							S2-2			S1-J3			[1][9] RG-188	PIN CONTROL
51	—							S2-J3			XA2-38			[8] RG-188	PIN CONTROL
	—							S3-1			CR2-J2			[1][8] RG-188	DET VIDEO (1-4)
52	24	9						S3-2			XA2-66			NOTES [1][8]	DET VIDEO (1-4)
	22	6						VR1-1			AR2-VDC			NOTE [8]	+24 VDC
53	22	O						VR1-2			WT1			NOTE [8]	GROUND

TITLE:

SIZE A | CODE IDENT NO. 14482 | WL 700511 | REV.

SHEET 8

OCT 25 1982

WIRING LIST

WIRE NO.	DESCRIPTION				ITEM NO	FROM				TO				REMARKS	FUNCTION
	GAGE	COLOR				SYMBOL	TERM. ITEM NO.	CIRCUIT POINT	STATION NO.	STATION NO	CIRCUIT POINT	TERM. ITEM NO.	SYMBOL		
		BODY	1st TCR	2nd TCR											
1	22	O						A1-GND			WT1			NOTE [7]	MIXER GND
2	22	9	2					A1-VDC			TB1-3			NOTE [7]	MIXER BIAS
3	—							A1-I			J1-A2			RG-188	IF OUT
4	22	O						AR1-GND			WT1			NOTE [8]	AMP RETURN
5	22	9	2					AR1-VDC			TB1-3			NOTE [8]	AMP BIAS
6	22	O						AR2-GND			WT1			NOTE [3]	AMP RETURN
7	22	6						AR2-VDC			VR1-1			NOTE [8]	AMP BIAS
8	—							CR1-J2			XA2-34			[1][9] RG-188	DET VIDEO
9	—							CR2-J2			S3-1			[1][8] RG-188	DET VIDEO (1-4)
10	—							CR3-J2			XA2-74			[8] RG-188	DET VIDEO (.1-1)
11	22	7						J1-1			TB1-1				+28V (A)
12	22	9	2					J1-2			TB1-3				+15V
13	22	4						J1-3			TB1-4				+5V
14	22	9	7					J1-4			TB1-5				-15V
15	22	5						J1-5			TB1-6				-22V
16	22	O						J1-6			WT1				GROUND
17	22	O						J1-7			WT1				GROUND

TITLE: WIRE LIST WJ 1251-XX RF SOURCES	SIZE A	CODE IDENT NO. 14482	WL 700511	REV
			SHEET 5	

WATKINS-JOHNSON COMPANY

WIRING LIST

WIRE NO	DESCRIPTION GAGE	COLOR BODY	COLOR 1st TCR	COLOR 2nd TCR	ITEM NO	FROM SYMBOL	FROM TERM. ITEM NO.	FROM CIRCUIT POINT	FROM STATION NO	TO STATION NO	TO CIRCUIT POINT	TO TERM ITEM NO	TO SYMBOL	REMARKS	FUNCTION
								J1-8			N/C				
18	24	9						J1-9			R1-2				D/A GND
19	24	9						J1-10			XA2-67				D/A INPUT
								J1-11			N/C				
								J1-12			N/C				
20	24	9						J1-13			XA2-78			NOTE [3]	BREAK OUT
								J1-14			N/C				
21	24	9						J1-15			XA2-24				FINE TUNE IN
22	24	9						J1-16			XA2-56				HOLDOFF
23	24	9						J1-17			XA2-54				HOLDOFF
24								J1-18			NOTE [2]				BAND CODE 8
25								J1-19			NOTE [2]				BAND CODE 16
26								J1-20			NOTE [2]				BAND CODE 1
27								J1-21			NOTE [2]				BAND CODE 2
28								J1-22			NOTE [2]				BAND CODE 4
29	22	2						J1-23			TB1-2			—	+28V
								J1-24			N/C				

TITLE:	SIZE	CODE IDENT NO	WL	REV
	A	14482	700511	

SHEET 6

WATKINS-JOHNSON COMPANY

WIRING LIST

WIRE NO.	DESCRIPTION GAGE	COLOR BODY	COLOR 1st TCR	COLOR 2nd TCR	ITEM NO	FROM SYMBOL	FROM TERM. ITEM NO	FROM CIRCUIT POINT	FROM STATION NO	TO STATION NO.	TO CIRCUIT POINT	TO TERM. ITEM NO.	TO SYMBOL	REMARKS	FUNCTION
30	—							J1-A1			AR2-IN			[8] RG-133	100 MHz IN
	—							J1-A2			A1-I			RG-188	IF OUT
31	24	9						Q1-B			XA2-62				Coarse Tune
32	22	9	2					Q1-C			TB1-3				+15V
	24	9						Q1-E			NOTE [3]				Main Coil (+)
33	24	9						Q2-B			XA2-68			NOTE [4]	OSC BIAS
34	22	5						Q2-C			TB1-6			NOTE [4]	-22V
35	24	9						Q2-E			XA2-69			NOTE [4]	OSC BIAS
	24	9						Q2-E			NOTE [3]			NOTE [4]	OSC BIAS
36	24	9						Q3-B			XA2-2				Fine Tune
37	22	9	2					Q3-C			TB1-3				+15V
38	24	9						Q3-E			Q4-E				FM Coil (-)
	24	9						Q3-E			NOTE [3]				FM Coil (-)
39	24	9						Q4-B			XA2-4				Fine Tune
40	22	9	7					Q4-C			TB1-5				-15V
	24	9						Q4-E			Q3-E				FM Coil (-)
41	24	9						R1-1			XA2-64				Main Coil (-)

TITLE:	SIZE	CODE IDENT NO	WL	REV
	A	14482	700511	

SHEET 7

REVISIONS				
LTR	DESCRIPTION	ECO	DATE	APPROVED

Revision A

Customer HUGHES

Purchase Order 28-766603-C-JN

Date Acceptance Test Completed 11/4/82

	Model No.	Serial No.	Assembly No.
Mainframe	WJ-1250A-	012	702001-001
RF Source	WJ-1251-9M	001	700024-001
	WJ-1251__		
	WJ-1251__		
	WJ-1251__		
	WJ-1251__		
	WJ-1251__		
Multisource Chassis	WJ-1253A(C)		
	WJ-1253A(C)		
Interface Module	WJ-1253B(D)		
RF Switching Unit	WJ-1256__		

REVISION STATUS	SHT NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
	ISSUE LETTER																									

APPROVALS			
	REQ'D	SIGNATURE	DATE
ORIGINATOR	X		10/11/77
R & D ENG.	X		10/24/77
MANUFACT'G	X		10/25/77
PROD. ENG.	X		10/29/77
Q. A. R.	X		771024
APPLIC. ENG.	X		10/29/77

CONTR. NO.

PROJ. NO.

WJ-773

WATKINS · JOHNSON COMPANY
ELECTRON DEVICES. ELECTRONIC SYSTEMS
PALO ALTO CALIFORNIA

CATEGORY

PRODUCTION ATP

TITLE WJ-1250/1250A or WJ-1255A, WJ-1253A(C)/ 1253B(D), and WJ-1256 Frequency Synthesizer System

CODE IDENT	DIV	NO.	SHEET	OF
14482	13	624303	1	16

1.0 SCOPE

This document defines the procedures to be followed in final testing of the WJ-1250/1250A or WJ-1255A with various combinations of WJ-1251- XX, WJ-1253A (C), WJ-1253 B (D), and WJ-1256-X frequency synthesizer system.

2.0 PROCEDURE GENERAL REQUIREMENTS

2.1 Test Conditions

All functional testing shall be conducted under the environment of normal room conditions. Normal room conditions consist of an air temperature of 75 ± 10°F and a relative humidity of 50% ± 30%.

2.2 Test Sequence

There is no specific requirement to perform the tests described in this document in the sequence shown.

2.3 Test Equipment

All instrumentation shall be calibrated against Watkins-Johnson Company standards at scheduled intervals. All calibration shall be performed in accordance with QAI 100536, Electronic Calibration Program and Procedures Manual. The equipment listed in P2.3 shall be used for acceptance testing.

However, equivalent equipment may be used if it can be determined that the substitute instrument meets or exceeds the minimum applicable specifications of the replaced instrument. Record in data P2.3 the I.D. number and last calibration date of test equipment used, where applicable.

2.4 Data

All data, as directed in this document, shall be recorded on Acceptance Test Sheets -- copies of which shall be supplied to the customer with the deliverable hardware. Final alignment data for the appropriate WJ-1250 Frequency Synthesizer must be included.

2.5 Examination of the Product

All units shall be examined to verify that the design, construction, physical dimensions, finish, marking, and workmanship are in accordance with applicable requirements.

2.6 Engineering Approval

Prior to the start of this acceptance test Engineering must verify by their signature on Page 7 that the system is performing properly and meeting all specifications.

3.0 TEST PROCEDURES

3.1 Test Set-Up

Assemble and connect the equipment as shown in Figure 1.

3.2 LED Display/Keyboard

3.2.1 Set the WJ-1250/1250A or WJ-1255A for 230 VAC operation. Record in Data Para. 3.2.

3.2.2 Select the ("SOURCE"- Switch/Indicator) "LOCAL" programming mode and record in data, Para. 3.2, that this is shown by the "SOURCE" indicator.

3.2.3 Depress the keyboard numbers indicated in Data Para. 3.2 and verify (X) that the correct number is displayed.

3.2.4 Depress on the keyboard any valid frequency for the installed RF Source. Observe that the LED indicator on the display is on (unentered frequency). Verify in Data Para. 3.2. Depress ENTER on the keyboard and verify that the LED indicator in the display is off (entered frequency).

3.2.5 Depress the first 2 digits of a valid frequency and then depress ENTER on the keyboard. Observe that all trailing zeros are automatically entered on the display.

3.2.6 WJ-1250A or 1255A only: Program the edit function to the Edit mode. Edit each digit individually except for the most significant digit. Verify and record in Data Para. 3.2.

WJ-1250A or WJ-1255A ONLY

3.2.7 Program a valid "LOW F", "HIGH F", "F INC," AND "DWELL" for the WJ-1250A or WJ-1255A.

3.2.8 Depress "START SWEEP" and verify in Data Para. 3.2 that system has programmed and swept properly.

3.2.9 Depress "UP/DOWN" and initiate sweep. Verify in Data Para. 3.2 that system is sweeping down (HIGH F to LOW F). Depress "UP/DOWN" and verify in Data Para. 3.2 that system is sweeping up (LOW F to HIGH F).

3.2.10 Depress "STOP/STEP" and verify that the sweep stops and that it single steps by depressing the "STOP/STEP" again. Verify proper operation in Data Para. 3.2.

3.2.11 Put "DWELL/SLEW" in DWELL position and initiate sweep. Throw FM Input Switch (S3) to UNLOCKED position. Verify in Data Para. 3.2 that sweep stops.

3.2.12 Put "DWELL/SLEW" in SLEW position and initiate sweep. Throw FM Input Switch (S3) to UNLOCKED position. Verify in Data Para. 3.2 that sweep continues.

3.3 FM Input

3.3.1 Assemble and connect the equipment as shown in Figure 1.

3.3.2 When the FM Input Switch (S3 is in the LOCKED/UNLOCKED position, the WJ-1250/1255 "STATUS" indicator should show LOCKED/UNLOCKED. Visually verify each condition and record in Data Para. 3.3. (X).

3.3.3 Connect DC power supply to FM input (J3) and throw FM Input Switch (S3) to UNLOCKED. Observe and record in Data Para. 3.3 the variation in output frequency as the DC voltage is varied from -10V to +10V.

3.3.4 Disconnect the DC power supply and throw FM Input Switch (S3) to LOCKED.

3.4 Reference Oscillator

Connect the frequency counter to the 5 MHz Reference Input jack. With the reference switch in the INTERNAL position, verify and record in Data Para. 3.4 that 5 MHz (Optional 1 MHz, 2 MHz, or 10 MHz) is observed. Reconnect the frequency counter to the RF Source.

3.5 RF Source Identification

3.5.1 Program and measure on a frequency counter a valid output frequency. Record in Data Para. 3.5. Program to a frequency below and above the frequency range of the RF Source. Verify in Data Para. 3.5 that (a) the actual output frequency does not change, (b) the LED display flashes with the in-valid frequency, and (c) depressing CLEAR restores the display to the programmed frequency out.

3.5.2 Turn off the WJ-1250A or WJ-1255A and then back on. Verify that the unit powers up to the lower band edge frequency and record in Data Para. 3.5.

3.6 Remote Programming

Various types of programmers may be used dependent upon the type of interface purchased. Record in Data Para. 3.6 the type of interface.

3.6.1 Select (source-switch/indicator) the "REMOTE" programming mode and verify that this is shown the "SOURCE" indicator in Data Para. 3.6. Visually verify "REMOTE" indicator is lit. Record in Data Para. 3.6.

3.6.2 Program the Remote Programmer to ten different frequencies for a single RF Source system. For a multiple RF Source system program to four frequencies in each RF Source. Verify that the LED Display frequency is the same as programmed and record in Data Para. 3.6.

3.7 RF Source

3.7.1 Record in Data Para. 3.7 the (a) RF Source number (i.e., 1 of 3), (b) model number (i.e., WJ-1251-4), c) the frequency range (i.e., 4 to 8 GHz), (d) serial number, (e) minimum power out (i.e., +10 dBm), (f) assembly number (i.e., 623261-001), and (g) leveled power variation specification (i.e., ±0.75 dB). This must be completed prior to beginning the measurements. Set the WJ-1250/1250A or WJ-1255A for 115 VAC operation.

3.7.2 Program the frequency (manual mode) to various values from the lower frequency limit to the upper frequency limit of each RF Source. Program 10 different frequencies for each source. Record in Data Para. 3.7 (a) programmed frequency, (b) actual frequency, and (c) the calculated frequency difference.

3.7.3 Disconnect the frequency counter and connect the power meter as shown in Figure 1. Program the same frequencies as in Paragraph 3.7.2 and record in Data Para. 3.7 the measured power out for each frequency. Calculate and record the power variation over frequency.

3.8 Frequency Spectrum

Connect the HP141T/855X spectrum analyzer to the output of the RF Source. Program to any frequency. Set the controls to the following settings:

Control	Setting 1	Setting 2
Scan Width	10 KHz/Div.	50 KHz/Div.
Band Width	1 KHz	1 KHz
Vertical	10 dB/Div.	10 dB/Div.
Video Filter	10 Hz	10 Hz

Take a photograph at both settings and record in Data Para. 3.8.

3.9 Sweep

Various types of programmers may be used dependent upon the type of interface purchased. The WJ-1250A and WJ-1255A have built -in sweep functions.

3.9.1 Select Source-Switch/Indicator) to "REMOTE" for external digital sweep units and "LOCAL" for the WJ-1250A or WJ-1255A.

3.9.2 Program over (a) 200 MHz bandwidth minimum in 100 KHz increments, (b) from the lower limit to the upper limit in 2 MHz increments for each RF Source and (c) 100 KHz bandwidth in 100 Hz increments (WJ-1255A only). Record in Data Para. 3.8 that unit was swept over the various ranges without the sweep being stopped for an UNLOCKED condition.

3.10 Additional RF Sources

Repeat steps 3.7 to 3.9 for each RF Source of the system. Data Para. 3.7 thru 3.9 should be completed for each RF Source.

4.0 SHIPPING CHECK LIST

All assemblies, test data, and manuals shown and recorded in Data Para. 4.0 must be delivered to the customer. The Acceptance Test is not complete until all portions of Data Para. 4.0 are met.

FINAL TEST DATA

Part No. 702001-01 Serial No. 012 Date of Test 11/3/82

Conducted By [signature] Date 11/3/82

Witnessed By WJ [signature] Date 11/3/82

Engineering Approval [signature] Date 11/3/82

WATKINS · JOHNSON COMPANY ELECTRON DEVICES ELECTRONIC SYSTEMS PALO ALTO CALIFORNIA	CODE IDENT 14482	DIV 13	NO.	SHEET

DATA PARA. 2.3

		I.D. Number	Last Cal Date
1.	~~Hewlett Packard~~ SYSTRON/DONNER Model 5340A Frequency Counter	62104	4-15-82
2.	~~General Microwave~~ HP 436A 454 Power Meter	69482	10-19-81
3.	~~General Microwave~~ HP 848A Power Meter RF Head	55-4750	9-28-81
4.	DC Power Supply /Digital Voltmeter ~~Fluke 8600A~~ DATA PRECISION	68785	9-28-81
5.	Spectrum Analyzer HP141T HP8555A HP8552B	61483 61485 ~~61498~~ 142411	10-5-82 10-5-82 ~~10-5-82~~
6.	WJ-1250/1250A or WJ-1255A Remote Programmer as applicable to System	Model No. N/A Assembly No. N/A	
7.	RF Attenuators 3dB, 6dB, 10dB, 20 dB HP8491 series (Type N) or OSM 20610 series (Type SMA)	N/A	N/A

MJ 11/3/82

N/A - Not applicable

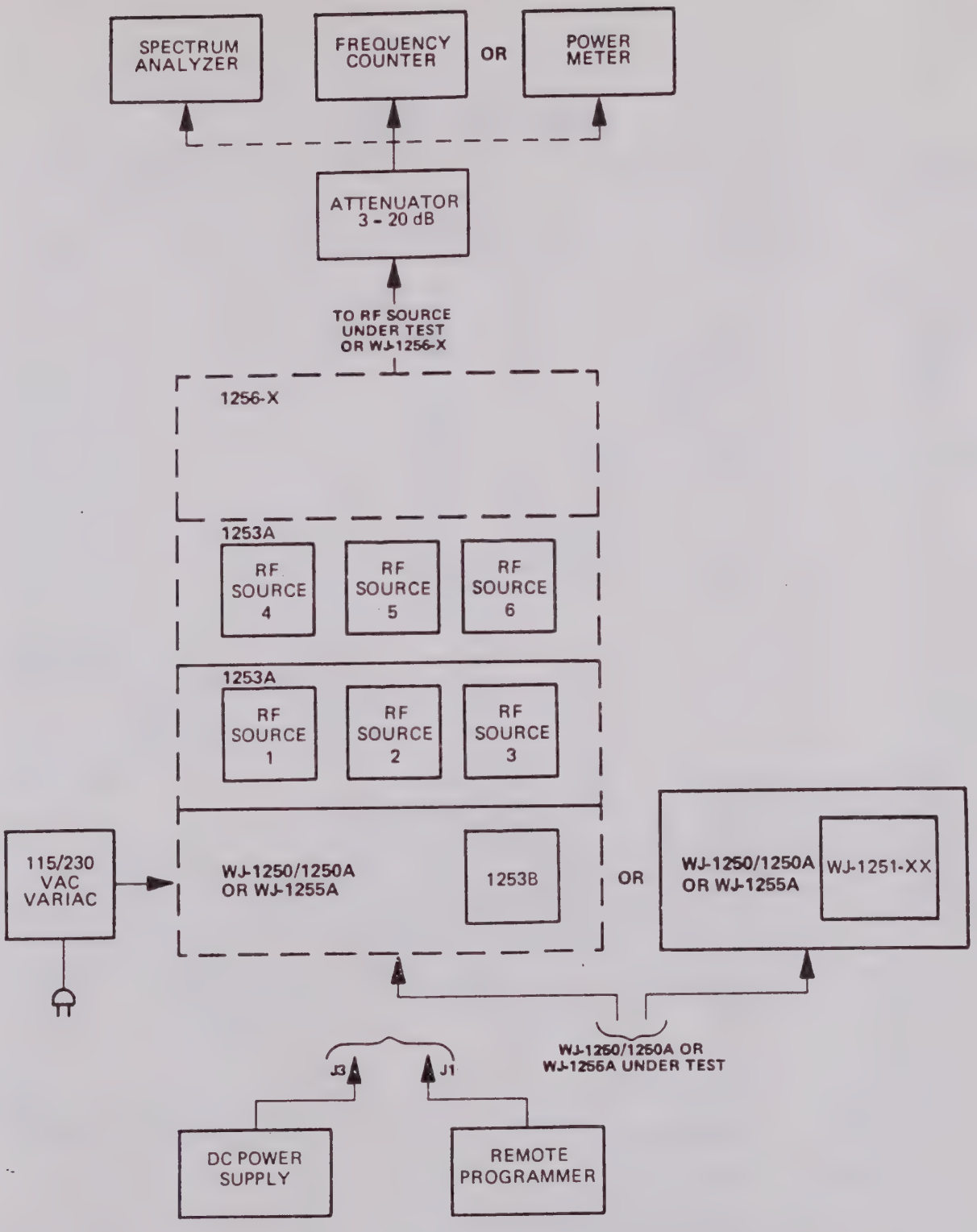


FIGURE 1

WATKINS-JOHNSON COMPANY 3333 HILLVIEW AVENUE PALO ALTO CALIFORNIA	CODE IDENT 14482	DIV	NO. 624303	SHEET 9

DATA PARA. 3.2
LED DISPLAY/KEYBOARD

230 VAC X (X)

"LOCAL" Indication X (X)

Keyboard —1250 — —1255A—	LED Display (X)
b 00000 000	X
1 11111 111	X
2 22222 222	X
3 33333 333	X
4 44444 444	X
5 55555 555	X
6 66666 666	X
7 77777 777	X
8 88888 888	X
9 99999 999	X

Enter Display Indicator

	(X)
Unentered (on)	X
Entered (off)	X

Trailing Zero Entry

18.0 Enter Zeros Entered (X) X

18.0000
(Random Selection)

Data for WJ-1250A or WJ-1255A Only

Edit X (X)

"Stop/Step" (X) X
"Up" (X) X
"Dwell (X) X

"Digital Sweep (X) X
"Down" (X) X
"Slew" (X) X

DATA PARA. 3.3
FM INPUT

Switch Position	Status Indicator (X)	DC Input (VDC)		Frequency	FM Range
Locked	X	+10		18.038 GHz	.038 GHz
Unlocked	X	0	Ref.	17.9998 GHz	N/A
		-10		17.986 GHz	.0138 GHz

* FM Range = Frequency (±10) - Ref.
** FM Tolerance => ±20 MHz

WJ 8 11/3/82

DATA PARA. 3.4

Internal	5 MHz	X
	1 MHz	
	2 MHz	
	10 MHz	

DATA PARA. 3.5
RF SOURCE IDENTIFICATION

Previous Frequency Out 18.0000 GHz

	Display Frequency (GHz)	Actual Frequency (GHz)	Flashing Display Yes	No
Above	26.000	18.0000	X(X)	
Clear	18.0000	18.0000		X(X)
Below	16.0000	18.0000	X(X)	
Clear	16.0000	16.0000		X(X)

Lower Band Edge* 17.0 GHz

Lower UP Frequency* 17.0 GHz

*Should be the lower limit of the calibrated RF Source.

DATA PARA. 3.6
REMOTE PROGRAMMING

Parallel BCD	(X)
Standard Computer	(X)
Standard Bus (IEEE 488-1975)	X (X)

WJ 8 11/3/82

DATA PARA. 3.6 (CONT.)
REMOTE PROGRAMMING

REMOTE Indication X (X)

Programmed[1] Frequency (GHz)	Display Frequency Same as Programmed Yes	No	UNLOCKED[2] (X)
17.0	X (X)		
17.5	X (X)		
18.0	X (X)		
18.5	X (X)		
19.5	X (X)		
20.0	X (X)		
21.0	X (X)		
22.5	X (X)		
23.5	X (X)		
25.0	X (X)		
	WJ-B 11/3/82 (X)		
	(X)		
	(X)		
	(X)		
	(X)		
	(X)		
	(X)		
	(X)		
	(X)		
	(X)		

1 Program 10 frequencies for a signal RF Source System and 4 frequencies per RF source for a multi-source system.

2 An UNLOCKED indication at any frequency means that the unit has failed and the test is terminated.

DATA PARA. 3.7

RF Source Number 1 of 1

WJ-1251- 9M 17 to 25.5 GHz RF Source

Serial Number 001 Minimum Power Out 6 (~~dBm~~/mW)

Assembly Number 700029-001 Power Variation - less than ± _____ dB _____ N/A

115 VAC X (X)

Programmed Frequency[1] (GHz)	Actual Frequency (GHz)	Frequency Difference[2] (KH z)	Measured Power Out (~~dBm~~/mW)
17.0000	17.0000	ϕ	8.91
17.0002	17.0002	ϕ	8.91
17.0004	17.0004	ϕ	8.91
18.0004	18.0004	ϕ	8.54
18.0006	18.0006	ϕ	8.51
18.0008	18.0008	ϕ	8.51
20.0004	20.0004	ϕ	6.09
22.0008	22.0008	ϕ	6.98
24.0004	24.0004	ϕ	6.51
25.0006	25.0006	ϕ	7.61

Power Variation ($\frac{\text{maximum power - minimum power}}{}$) = ± 1.41 dB

1 * At least one pair of frequencies should be separated by the resolution of the unit (WJ-1250 (A) - 100 KHz, WJ-1255 A - 100 Hz).

2 Frequency difference = Programmed - Actual. Shall be less than 1 KHz for the WJ-1250 (A) and WJ-1255A.

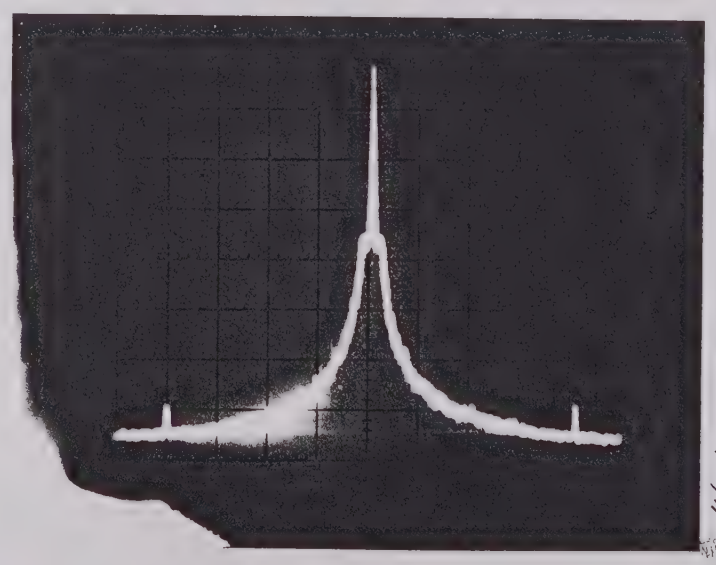
* Resolution of the WJ 1250A/WJ 1251-9M is 200 KHz. NM 11-3-82

FREQUENCY SPECTRUM PHOTOGRAPHS

11/3/82

11/3/82

Frequency 18.0 GHz
Band Width 1 KHz
Scan Width 10 KHz/Div.
Vertical 10 dB/Div.
Video Filter 10 Hz



11/3/82

11/3/82

Frequency 18.00 GHz
Band Width 1 KHz
Scan Width 50 KHz/Div.
Vertical 10 dB/Div.
Video Filter 10 Hz

DATA PARA. 3.9

Successful Sweep Yes (X) X NO_____

An "UNLOCKED" indication at any frequency means the system has failed and the test is terminated.

WJ 11/3/82

DATA PARA. 4.0 SHIPPING CHECK LIST

Description	Model No.	Serial No.	Part No.	Qnty.	QA Verification (X)
ALL HARDWARE AS SHOWN ON PAGE 1					
Manual (Frequency Synthesizer)	WJ-125	N/A	N/A	1	X
Manual (RF Source)	WJ-1251	N/A	N/A	1	Optional
Fuses (Slow Blow - 2A)	N/A	N/A	N/A	2	X
Harmonic Generator Alignment Data	WJ-5129		N/A	1	X
System with WJ-1253 A (C)/1253 B(D) (Additional Items)					
Manual (Multi-Source Chasis)	WJ-1253	N/A	N/A	1	(As Required)
Manual (Interface Module)	WJ-1253	N/A	N/A	1	(As Required)
System with WJ-1256-X (Additional Items)					
Manual (RF Switching Unit)	WJ-1256	N/A	N/A	1	(As Required

HARMONIC GENERATOR ALIGNMENT
(DRIVER BOARD ASSEMBLY 701011-0XX)

HARMONIC GENERATOR: Model No. WJ5129-37 Serial No. 2948
USED ON (MAINFRAME): WJ1250A 012
CUSTOMER: HUGHES
ALIGNMENT PERFORMED BY: R. THOMAS Date: 10/8/82

	Band Segment	Potentiometers, Tuning Adjust	Frequency (GHz)	Minimum Tuning Voltage, Vmin (Volts)	Maximum Tuning Voltage, Vmax (Volts)	Tuning Window Vmax - Vmin (mV)	Optimum Tuning Voltage (Vmax - Vmin)/2 (Volts)	Final Setting Tuning Voltage (Volts)	Potentiometer Bias Adjust	Final Setting Bias Voltage (Volts)
36.0	A	R2A	18.0	4430	4457	27	4443	4444	R3A	.309
38.6		R1A	19.3	4778	4804	26	4791	4790		
38.8	B	R2B	19.40	4805	4835	30	4820	4815	R3B	.700
39.8		R1B	19.9	4939	4965	26	4953	4948		
	C	R2C	2.0	.378	.406	28	.392	.392	R3C	.400
			3.0	.628	.655	27	.642	.642		
			4.0	.878	.907	29	.893	.892		
			5.0	1.132	1.156	24	1.144	1.142		
			6.0	1.382	1.405	23	1.394	1.392		
		R1C	7.99	1.854	1.877	18	1.866	1.867		
	D	R2D	16.0	3.914	3.938	24	3.926	3.925	R3D	.700
			16.5	4.043	4.070	27	4.057	4.055		
			17.0	4.174	4.199	25	4.187	4.185		
		R1D	17.99	4411	4433	22	4422	4.420		
17.0	E	R2E	8.0	1.879	1.906	27	1.893	1.896	R3E	.400
			8.5	2.004	2.031	27	2.017	2.021		
			9.0	2.131	2.156	25	2.144	2.146		
			9.5	2.257	2.282	25	2.270	2.272		
19.8		R1E	9.99	2.360	2.378	18	2.369	2.371		
20.0	F	R2F	10.0	2.381	2.408	27	2.395	2.393	R3F	.600
			11.0	2.634	2.658	24	2.646	2.645		
25.5			12.0	2.887	2.913	26	2.900	2.900		
↓			13.0	3.142	3.166	24	3.154	3.153		
3.077			13.5	3.269	3.296	27	3.283	3.279		
		R1F	13.99	3.376	3.395	19	3.386	3.381		
	G	R2G	14.0	3.399	3.424	25	3.412	3.411	R3G	.723
			14.5	3.527	3.553	26	3.540	3.540		
			15.0	3.657	3.681	24	3.669	3.668		
		R1G	15.99	3894	3900	6	3897	3.896		

Band Segments for This Unit Are as Follows:

	From	GHz	to	GHz
A	18.0		19.3	
B	19.4		19.9	
C	2.0		7.99	
D	16.0		17.99	
E	8.0		9.99	
F	10.0		13.99	
G	14.0		15.99	

Final
NRM
10/29/82

40.0 | MOD | 20.01 | 4966 | 4996 | 30 | 4981 | 4978 |

HARMONIC GENERATOR ALIGNMENT
(DRIVER BOARD ASSEMBLY 701011-0XX)

HARMONIC GENERATOR: Model No. WJ5129-37 Serial No. 2948
USED ON (MAINFRAME): WJ1250A 012
CUSTOMER: HUGHES
ALIGNMENT PERFORMED BY: R. THOMAS Date: 10/8/82

	Band Segment	Potentiometers, Tuning Adjust	Frequency (GHz)	Minimum Tuning Voltage, Vmin (Volts)	Maximum Tuning Voltage, Vmax (Volts)	Tuning Window Vmax - Vmin (mV)	Optimum Tuning Voltage $\frac{V_{max}+V_{min}}{2}$ (Volts)	Final Setting Tuning Voltage (Volts)	Potentiometer Bias Adjust	Final Setting Bias Voltage (Volts)
36.0		R2A	18.0	4430	4457	27	4443	4444		
	A								R3A	.309
38.6		R1A	19.3	4778	4804	26	4791	4790		
38.8		R2B	19.40	4805	4835	30	4820	4815		
	B								R3B	.700
39.8		R1B	19.9	4939	4965	26	4953	4948		
		R2C	2.0	.378	.406	28	.392	.392		
			3.0	.628	.655	27	.642	.642		
	C		4.0	.878	.907	29	.893	.892	R3C	.400
			5.0	1.132	1156	24	1.144	1.142		
			6.0	1.382	1.405	23	1.394	1.392		
		R1C	7.99	1.859	1.877	18	1.868	1.867		
		R2D	16.0	3.914	3.938	24	3.926	3.925		
	D		16.5	4.043	4.070	27	4.057	4.055	R3D	.700
			17.0	4.174	4.199	25	4.187	4.185		
		R1D	17.99	4.411	4.433	22	4.422	4.420		
		R2E	8.0	1.879	1.906	27	1.893	1.896		
17.0			8.5	2.004	2.031	27	2.017	2.021		
	E		9.0	2.131	2.156	25	2.144	2.146	R3E	.400
			9.5	2.257	2.282	25	2.270	2.272		
19.8		R1E	9.99	2.360	2.378	18	2.369	2.371		
20.0		R2F	10.0	2.381	2.408	27	2.395	2.393		
			11.0	2.634	2.658	24	2.646	2.645		
	F		12.0	2.887	2.913	26	2.900	2.900	R3F	.600
25.5			13.0	3.142	3.166	24	3.154	3.153		
↓			13.5	3.269	3.296	27	3.283	3.279		
3.077		R1F	13.99	3.376	3.395	19	3.386	3.381		
		R2G	14.0	3.399	3.424	25	3.412	3.411		
	G		14.5	3.527	3.553	26	3.540	3.540	R3G	.723
			15.0	3.657	3.681	24	3.669	3.668		
		R1G	15.99	3.894	3.900	6	3.897	3.896		

Band Segments for This Unit Are as Follows:

	From	GHz	to	GHz
A	18.0	GHz	19.3	GHz
B	19.4		19.9	
C	2.0		7.99	
D	16.0		17.99	
E	8.0		9.99	
F	10.0		13.99	
G	14.0		15.99	

Final
NRM
10/29/82

40.0 | MADI | 20.01 | 4966 | 4996 | 30 | 4981 | 4978 |

OSCILLATOR COURSE TUNING
DATA SHEET

	Model No.	Serial No.
Oscillator:	WJ-5008-148	4660
Used On (RF Source)	WJ1251-9M	001
Customer:	HUGHES	
Alignment Performed By:	R THOMAS	Date 10/11/82

Pull in ± 27 MHz

1251-9 Freq	Temperature	Potentiometer Tuning Adjust	Frequency (GHz)	Room Temp: Tuning Voltage (Volts) TP2 - TP3	Room Temp: Error (MHz) Up	Room Temp: Error (MHz) Down	COLD 10°C: Tuning Voltage (Volts) TP2 - TP3	COLD 10°C: Error (MHz) Up	COLD 10°C: Error (MHz) Down	Tuning Voltage (Volts) TP2 - TP3	Error (MHz) Up	Error (MHz) Down	Positive Bias Adjust	Bias Voltage (Volts) TP4 - TP3	Negative Bias Adjust	Bias Voltage (Volts) TP5 - TP3
17		R34	8.5	2.988	-2	+2	2.99	+5	+9				~~R54~~		R61	-14
		~~(R26)~~											(R15)			
18			9.0	2.637	-4	+1	2.64	+3	+8							
19			9.5	2.787	-7	-2	2.79	-1	+5							
20			10.0	2.936	-6	-1	2.94	-1	+5							
21			10.5	3.085	-7	-3	3.09	-3	+3							
22			11.0	3.235	-6	-2	3.23	-1	+4							
23			11.5	3.384	-2	+2	3.38	+3	+8							
24			12.0	3.533	-1	+2	3.53	+4	+7							
25			12.5	3.682	-1	ϕ	3.68	+4	+6							
		~~(R24)~~											(R18)			
25.5		R26	12.75	3.757	-1		3.76	+6					R51		R58	14

Final

NTM 10/29/82

OSCILLATOR COURSE TUNING
DATA SHEET

	Model No.	Serial No.
Oscillator:	WJ-5008-18	4660
Used On (RF Source)	WJ1251-9M	001
Customer:	HUGHES	
Alignment Performed By:	R. THOMAS	Date 10/11/82

Pull in ± 27 MHz

1251-9 Freq	Potentiometer Tuning Adjust	Frequency (GHz)	Temperature: Room Temp — Tuning Voltage (Volts) TP2 - TP3	Error (MHz) Up	Error (MHz) Down	Temperature: COLD 10°C — Tuning Voltage (Volts) TP2 - TP3	Error (MHz) Up	Error (MHz) Down	Tuning Voltage (Volts) TP2 - TP3	Error (MHz) Up	Error (MHz) Down	Positive Bias Adjust	Bias Voltage (Volts) TP4 - TP3	Negative Bias Adjust	Bias Voltage (Volts) TP5 - TP3
17	R34	8.5	2.988	-2	+2	2.49	+5	+9				~~R54~~ (R15)		R61	-14
~~(R26)~~															
18		9.0	2.637	-4	+1	2.64	+3	+8							
19		9.5	2.787	-7	-2	2.79	-1	+5							
20		10.0	2.936	-6	-1	2.94	-1	+5							
21		10.5	3.085	-7	-3	3.09	-3	+3							
22		11.0	3.235	-6	-2	3.23	-1	+4							
23		11.5	3.384	-2	+2	3.38	+3	+8							
24		12.0	3.533	-1	+2	3.53	+4	+7							
25		12.5	3.682	-1	0	3.68	+4	+6							
~~(R21)~~												(R18)			
25.5	R26	12.75	3.757	-1		3.76	+6					R51		R58	14 V

Final

NTM 10/29/82

MP MASTER
MA32401